CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

CONTENTS

VOLUME 48 — JULY, 1941 — NUMBER 7

NEXT MONTH

In total, process industries are among the largest users of energy in the form of process steam, electricity and mechanical power. Now that additional demands are being put on power facilities of all kinds, and there is talk of power shortages on account of the tremendous requirements for defense, *Chem. & Met.* is preparing an up-to-the-minute report on "Power for Processes," designed to help you get the most from the equipment you already have, and to aid you in deciding how to proceed should that equipment not be adequate, even when used most efficiently. In addition to giving you tips from experts on how to step up energy output beyond apparent capacity, the report will discuss latest methods all along the power production line so far as they affect the process field.

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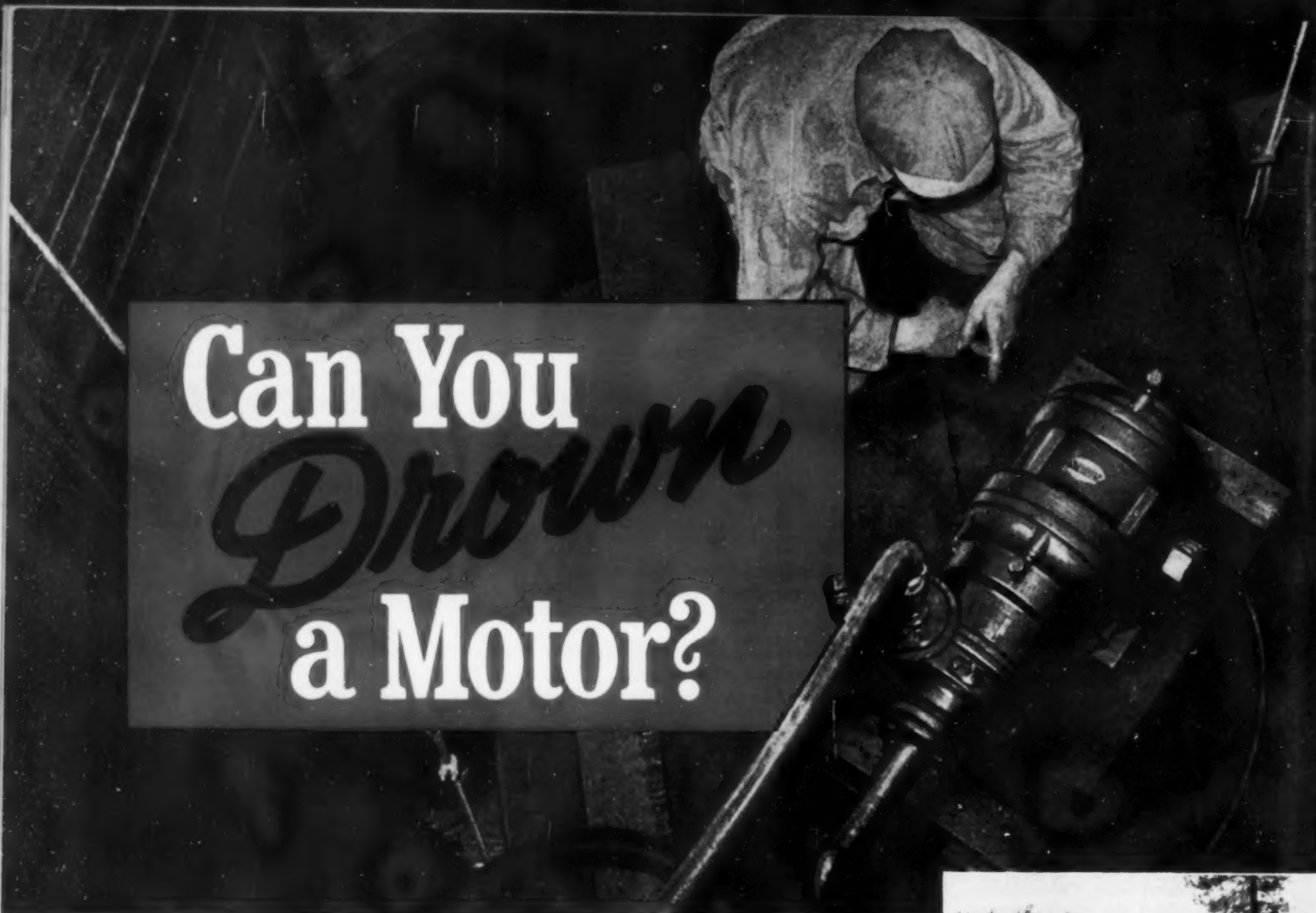

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CHEMICAL
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ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, *Editor*

JULY, 1941

RESEARCH, THE RESOURCE

INDUSTRIAL RESEARCH, in the words of President Roosevelt, is "one of the greatest resources in the Arsenal of Democracy." It is a storehouse of knowledge and experience on which we must rely heavily both "for the vigorous prosecution of our national defense program and the assurance of national progress after the emergency."

These statements came from the White House on May 29, 1941 in a letter transmitting to Congress a comprehensive report on "Industrial Research," which was prepared for the National Resources Planning Board under the direction of a special committee of the National Research Council. It gives us, for the first time, an official record of the research achievements of American industry and their relation to the national economy. Likewise it is a reference source that can be exceedingly helpful to industry, as well as to the government, in formulating plans and practices for continuing advances in utilizing the results of research in both pure and applied science.

One portion of the report deals with research in the national economy, its effect on growth and vitality of industry, its contribution to the high standards of American living. Another is concerned with the development and organization of research in large and small companies, in trade associations and university laboratories. But most personal interest on the part of the individual scientist and technologist probably centers in the chapter on "Careers in Research" and those dealing with opportunities, functions and responsibilities of "Men in Research." Some excerpts from the chemical engineering contribution are reprinted elsewhere in this issue, but the reader is especially urged to study the extent to which all the recognized disciplines of science—physics, chemistry, mathematics, biology, metallurgy and the several other fields of engineering—are applied in the different industries.

Research, in itself, has become a great industry in which the United States holds the leading position throughout the world. American industry employs more than 70,000 research workers in over 2,200 laboratories at an estimated annual cost of $300,000,000. Approximately two hundred manufacturers report expenditures for industrial research averaging 2 percent of their gross income —the percentage varying with company size and from one industry to another. Chemical industry heads the list, with median expenditures of 3 to 4 percent; but several process industries, notably petroleum and coal, rubber products and leather goods, fall in the lowest bracket with research appropriations of less than 1 percent of sales.

If research is to continue to hold its high place in the esteem of our fellow men, we may well ponder the following significant paragraph from the NRC report, which President Roosevelt quotes as a summary of the great changes that have come about through industrial research:

> "More efficient and economical methods have conserved our resources; new materials have made possible better products; and new products have contributed to the health, pleasure, and comfort of the general public. Such changes have not taken place without some temporary misfortunes. Here and there industries have disappeared and people have been temporarily thrown out of work, but the net result of 40 years of organized industrial research in this country has been the enrichment of life to an incalculable degree."

FROM AN

EMPHASIS ON DEVELOPMENT

By creating a new Office of Scientific Research and Development in the top-flight Office of Emergency Management, President Roosevelt has given high recognition to the work of the scientist and technologist. The old National Defense Research Committee, which has been handling the more scientific aspects of national defense, is now transferred to the new OSRD. Thus, it would seem that the machinery has at last been set up to utilize promptly and effectively the results of research in advancing the defense program.

This is as it should be. Too much of what has been done by NDRC, especially in the universities, has perhaps been too academic—too far-fetched. In the words of one critic, it has been aimed, not at this war, but at the next one and the one after that. Meanwhile there are engineers and development men in industry whose practical knowledge of processes and facilities can and should be quickly mobilized in the defense effort. Let's hope that OSRD, while not neglecting scientific research, will put at least equal emphasis on engineering development.

AGAIN, THE PROFESSIONAL UNION

Unionization of professional people raises important and difficult questions which are now being pressed for answer in the case of employees of certain California petroleum companies. There, again, certain CIO organizers are demanding that scientific and technical workers become members of their union.

The executive offices of the American Chemical Society and many of its California members are being drawn into this discussion. The chemists are very properly resisting all efforts to reduce the practice of science or engineering to the status of a trade. This does not imply that either the chemist or the chemical engineer is too "high hat" for his own good. It merely implies that these professional activities are so different from the activities of the artisan or the routine worker as to be unsuitable for the rigid restriction which unionization brings.

When those who happen to have been trained in science or engineering take an operating job, they may or may not lose their professional status. If such activity is merely for a training period of short duration, as in cadet engineering work, the men should retain their professional status. But a man who takes an artisan's job permanently, whether he has had college training or not, becomes thereby a legitimate object of union organization.

Fortunately, the wiser leaders of our professions recognize this distinction. They have, therefore, established a proper meeting ground on which union labor leaders and the leaders of chemistry and chemical engineering may confer. We may not see eye to eye with all of the union leaders. But we can and should have opportunity for straight-forward, reasonable conference with the spokesmen of organized labor.

Let us hope that the union officials can be not only open-minded in these discussions, but also properly influential in their supervision of subsidiary unions. If the organizer of non-professional groups does not recognize a proper limitation of his own effort, he may needlessly antagonize many management officials and thus make it more difficult for legitimate collective bargaining to develop without undue loss to either side.

U. S. RUBBER MONOPOLY

First strategic material to be taken over as a government monopoly is rubber. All importation is now restricted to the Rubber Reserve Co. and private buying of imported rubber is forbidden. This step was found necessary by the government in order to divert some imports into the stock pile, and to control the quantity of rubber used by each processor.

Effective July 1, the quantity of rubber which can be made up by each company was restricted to a named percentage of last year's business. Government orders must be filled ahead of civilian requirements. Hence, the percentage cut from 1940 indicated in the quota order will be much greater for civilian business than would at first appear.

This complete commodity control of rubber by the government is expected to extend to other strategics. It is frankly admitted in private by officials that tungsten, chromium, manganese, and certainly tin are the kinds of goods for which the

EDITORIAL VIEWPOINT

government will have to take over distribution, probably by ownership means. It is important, however, to realize that this "government ownership" is not subject to quite the same opposition as that which is commonly expressed by industry against the owning and running of plants competitive with private business. This form is simply a variation of goods control that has the same effect as the priorities and allocation programs.

CLOSER CANADIAN COOPERATION

INTEGRATION of the war efforts of the United States and Canada will be pushed by joint committees on economic coordination appointed recently by the two governments. This cooperation is essential now that they share the grave responsibility of defending the North American Continent against aggression.

Industries on both sides of the border have many problems in common and may find it advantageous to work together in determining policies and in sharing raw materials, patents, equipment, machine tools, and other supplies. Canada's chemical industry got an earlier start in munitions manufacture and having made great progress with its expansion program is now able to supply this country with at least part of the ammonia, aluminum, nickel, and certain other materials which we badly need pending completion of our own plants. And in turn we can ship cotton linters, toluol, acetone and alcohol that are required for the explosives industry of our northern neighbors.

Not only will this integration of effort prove to be advantageous while the war is in progress but it will be badly needed during the post-war period in order to prevent ruinous competition that otherwise is certain to result from the greatly expanded production facilities in Canada and the United States.

INVESTING IN THE FUTURE

WHEN ASKED recently what he considered the best and safest investment in these uncertain times, an eminent statesman said: "Put your money into education, if not for your own sons and daughters, then for your employees and those who are going to carry on the engineering and technology of your business!" We were reminded of that advice by the current announcement of the new Institute of Gas Technology to be established by September, 1941, and administered by the Illinois Institute of Technology in Chicago. Farseeing executives in seventeen of the leading natural and artificial gas companies of the United States are investing at least a million dollars in a ten-year program designed primarily to "train qualified young men, college graduates, for entrance as valuable employees of the gas industries."

Patterned quite closely, it would seem to us, after the highly successful Institute of Paper Chemistry at Appleton, Wis., the new "Gas Institute" will also conduct fundamental and applied research, collect and distribute scientific information pertaining to gas research and development work, at the same time serving as a central organization both to stimulate and co-ordinate the research in the gas industry.

Here, surely, is about the soundest investment any process industry could possibly make. In addition to regular dividends in the form of research results, there will soon be annual stock issues of highly preferred securities in the form of thoroughly trained post-graduates in science and engineering. Their future earning power for the gas industry is almost unlimited.

"RESPECTED FRIENDS"

ON JULY 20 the fourth and subsequent generations of the family of Joseph Elkinton will celebrate the 110th anniversary of the founding in Philadelphia of a remarkable enterprise. Originally a "soap and candle manufactory," its experiments during the late 1850's with silicate of soda led to the development of this then-new detergent for use during the critical days of the Civil War. The present name of the Philadelphia Quartz Co., adopted in 1864, marked the transition into more strictly chemical fields in which the loyal associates and descendants of the founder have long distinguished themselves and their company.

For more than a century the written communications from this company have borne the quaint salutation of the God-fearing and diligent Quaker who aligned his business practices with the high principles of his earlier calling as a missionary for the Society of Friends. Today, with the same sincerity, we address our congratulations and birthday greetings to one of chemical industry's most "Respected Friends."

The Chemical Engineer in Industrial Research

SIDNEY D. KIRKPATRICK *Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

Research is an important but scarcely the prime function of the chemical engineer in industry. Rather, he supplements the work of the research scientist by translating laboratory findings into terms of large-scale plant operations, and often by assisting management in determining the economic feasibility of many research projects. Chemical engineering contributions to "Research—A National Resource" are discussed in excerpts from Chapter 6 of Section IV of the 370-page report of the National Research Council to the National Resources Planning Board. —*Editors.*

About 20 years ago, chemists and chemical engineers were used almost interchangeably in research and development work. At that time it was common practice to start all new men in the analytical laboratories and subsequently to transfer into research those who developed originality and creative abilities. Some of those unfitted for investigational work went into production or sales, while a few remained in the laboratory as routine analysts.

Gradually, however, this situation has been corrected. There has arisen a fairly definite division of functions and responsibility between chemists and engineers in research and development work. W. L. Badger[1] has outlined this division as follows:

1. Strictly laboratory work should be done by the man with chemical background and training. Engineering considerations do not ordinarily enter into the actual conduct of research at this stage.

2. Pilot plant, semi-works, or similar development should be in the hands of the chemical engineer, not only with regard to the work itself but also with regard to its direction. Through this stage, however, the chemist, although not taking the responsibility, should be closely associated with the engineer.

3. Design of the final plant and its operation are the work of the chemical engineer alone. Once the process has passed the pilot-plant stage, the function of the chemist is largely to control quality and to advise in case of difficulties.

Dr. M. C. Whitaker of the American Cyanamid Co., calls attention to the direct contribution the chemical engineer can often make by advising research men as to the feasibility of proposed operations as well as by helping them to design special types of laboratory equipment required for this work.[2] He writes as follows:

> Chemical engineers fit into our research and development program from the time the job leaves the research laboratory until the customer has bought our goods and actually used them up in his own operations. In other words, chemical engineers take the laboratory processes, and with the assistance of the research chemist they design, develop, and operate pilot plants for experimental production. Then, on the basis of this experience, they design and install the full-scale production equipment, direct the operation of the plants, collaborate with the sales department in the introduction of the new materials and, finally, instruct the customer in his application and use of the end products of our research.

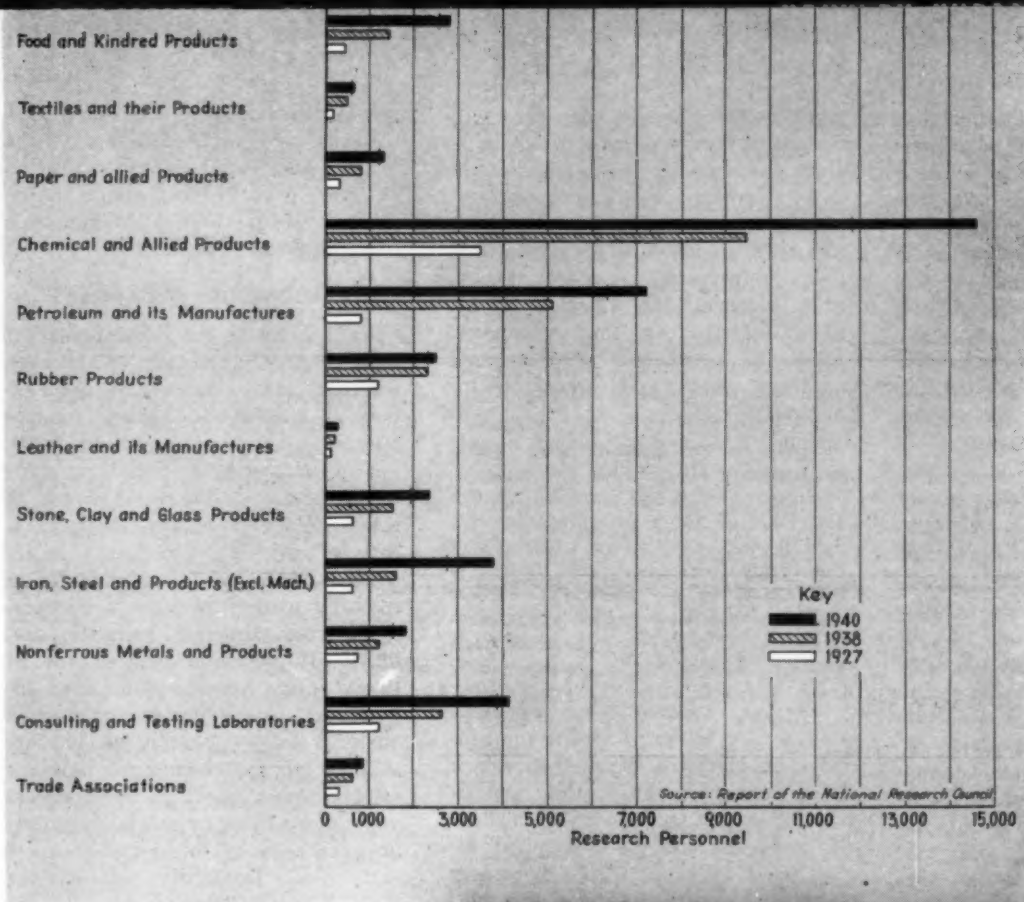
In general, most chemical companies try to divorce research from plant operation not only because the latter is a full-time job, but also because it generally calls for quite different qualifications. Nevertheless, some very successful companies make it a practice to start their young chemical engineers at the bottom of a development group and, after they have advanced to the point where they can undertake it, to assign them to a problem through the design, construction and operating steps, and finally make them operating heads of the process.

One of the greatest resources in the arsenal of democracy is our national ability and interest in Industrial Research. For the vigorous prosecution of our defense program and for the assurance of national progress after the emergency we rely heavily on the continued vitality of research by industry in both pure and applied science.

Our people can justly take pride in the record of the accomplishment by American industry. . . . The report presents a clear record of how successfully we have translated our old-time Yankee ingenuity for invention into American genius for research. Our scientists have uncovered and explained the secrets of nature, applied them to industry, and thus raised our standard of living, strengthened our defense and enriched our national life.

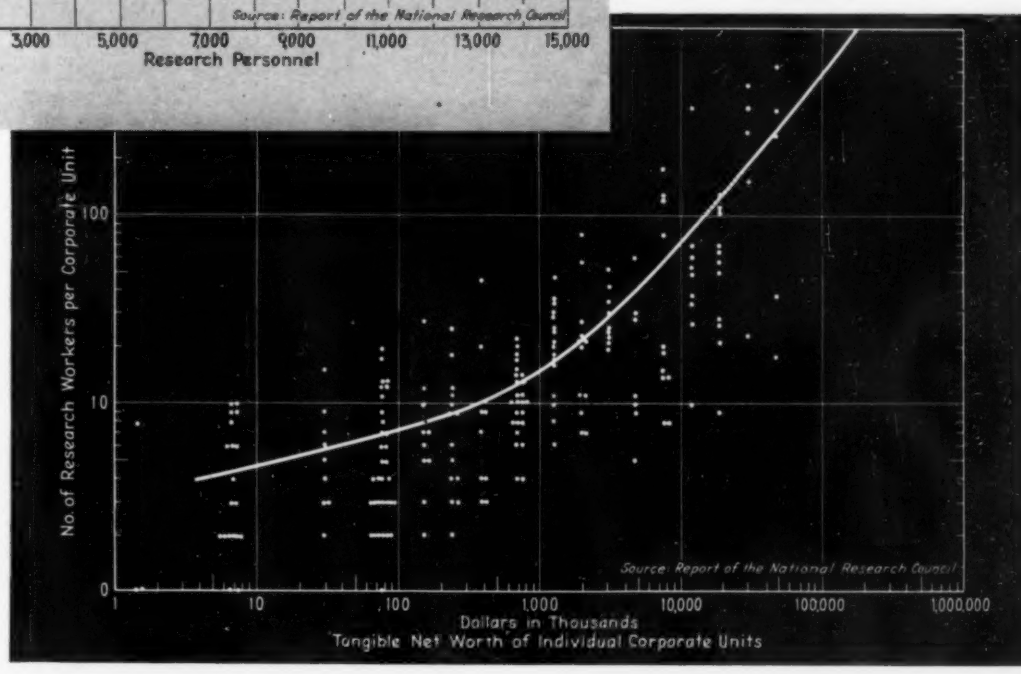
Franklin D Roosevelt

Excerpt from the President's message of May 29, transmitting to Congress "Research — A National Resource", a report of the National Research Council to the National Resources Planning Board.



Growth of research employment in various selected industries for 1927, 1938 and 1940 is shown in the figure to the left. The 1940 figures, primarily because of a more extensive coverage of the industries, are not directly comparable to those of 1927 and 1938. The small black bars indicate the 1940 figure comparable to those of the earlier years

Research staffs maintained by corporate units of various sizes in the chemical industry for 1940 are shown by the curve below. Each dot refers to an individual corporate unit, and the curve represents the average for the industry



The American Potash & Chemical Corp. follows a modification of this procedure. Its research director, Mr. W. A. Gale, writes:

On new developments we usually assign the investigation to some one man who will be expected to carry the problem, if all goes well, through the various stages of preliminary development. The detailed design and construction of the commercial plant is handled by the engineering department, but the research and development department must develop the preliminary design and specifications, such as volumes of material to be handled, quantities of heat to be transferred, and general type of equipment and flowsheet arrangement, and must prepare preliminary estimates on operating costs. Then when the plant is finally built, the research man will know more about it than almost anyone else, so he will be given a large part in supervising the testing, training of the crew and preliminary operations until such time as the plant is turned over to the production department as a smoothly operating unit. For this work we find that a man with good chemical engineering training is much more useful to us than a man who has been trained just as a chemist or physicist.

The true habitat of the chemical engineer is in what David E. Pierce[2] of Charles Lennig & Co. has called the "half-way house of industry"—the semi-works or pilot plant in which is determined the success or failure of most new processes. Here, half-way between the test-tube research and full-scale operations, the chemical engineer finds his greatest opportunity. It is his function to study a new process, to check its behavior under plant conditions, and to perfect the design and construction of equipment before the project is ready for commercial production. Dr. L. H. Baekeland is usually credited with the advice "Make your mistakes on the small scale and your profits on the large".

Pierce has summarized the four functions of the semi-works plant as follows: (1) To study new processes or new types of equipment in order to secure data for plant design; (2) To study proposed variations in old processes in order to increase yield or quality, or to improve the design of equipment; (3) To make sample batches of new products for introduction to the trade; and (4) To manufacture for sale new or special products for which the demand is not yet large enough to justify full-scale plant operations.

INSTITUTIONAL RESEARCH

Not all chemical engineers in research and development work are directly employed in industry. Many

are in the universities where an increasing volume of both fundamental and applied research work is being done. As will be noted later, the chemical engineer's direct contribution to fundamental research is largely confined to studies of the physical and chemical factors affecting unit operations and processes. Such investigations are concerned with advances in theory and knowledge of the underlying principles. Only recently has there been developed any appreciable need in university research organizations for chemical engineers who are proficient in pilot plant design and operation.

Government departments, as exemplified in the set-up of the four new regional laboratories of the United States Department of Agriculture, definitely provide for chemical engineering divisions to have charge of the semi-commercial development and the small-scale manufacture of products resulting from research. The Mellon Institute of Industrial Research and the Battelle Memorial Institute are both large employers of chemical engineers. Clyde E. Williams, director of Battelle, states that approximately 15 percent of their entire technical staff has had chemical engineering training. Although a number serve as operators of chemical pilot-plant equipment, many are also serving as supervisors, research engineers, and assistants in such fields as electrochemistry, ceramics, fuels, non-ferrous metallurgy, powder metallurgy, and many other phases of iron and steel research. Mr. Williams writes:

> We choose and advance men largely on their qualifications and abilities to do good research work. In other words, the primary requirements are broad training in fundamentals, ability to apply results and to think in a practical manner, imagination, inquisitiveness, and ability either to direct or to conduct research investigations. Chemical engineers are chosen for certain problems because of their specialized training or experience, but on the whole their ability to master and apply fundamentals is more important than the type of training.

TECHNOLOGICAL RESEARCH

Early practitioners of chemical engineering relied largely on the accumulated experience of those who, by methods of trial and error, had slowly developed the first crude chemical manufacturing processes. Empirical considerations still control many features of equipment design, construction, and operation in chemical industries. There is still some truth in the old saw that the engineer is a man who must draw sufficient conclusions from insufficient data. Nevertheless, fundamental research is gradually changing what was once an art into something that today approaches a more or less exact science. Dr. Charles M. A. Stine, of the du Pont company, noted the significance of this trend a dozen years ago, when he remarked:[3]

> Perhaps the characteristics which most clearly differentiate the chemical engineering of today from the earlier activities of those interested in this field is the *quantitative* treatment of the various unit operations, and it is this exact and quantitative treatment of these operations which constitutes the province of modern chemical engineering.

Further evidence from the same source may be noted in the publications on chemical engineering which have come from the du Pont experimental station in the period 1939-40. A comprehensive list compiled by Thomas H. Chilton[1] shows 42 papers dealing (quantitatively in most cases) with the following unit operations: Fluid flow (11 papers), heat transfer (7 papers), distillation, boiling and condensation (9 papers), absorption (4 papers), drying (2 papers), mechanical separation (1 paper). Five other papers dealt with corrosion and materials of construction, while two were concerned with broader reviews of research problems.

The petroleum industry has been a productive source of fundamental chemical engineering research on distillation, heat transfer, and the diffusional processes. Public utilities have sponsored invaluable work on the important unit operations and processes involved in fuel production and utilization. All this has been reflected in more efficient equipment and processes for these industries. In addition, manufacturers as well as users of chemical engineering equipment have participated greatly in this advance.

Apart from quantitative research on unit operations and design and performance studies by the equipment manufacturers, there is a broad field of chemical engineering activity concerned with the development of entirely new manufacturing processes. Here all the chemical engineer's knowledge and resourcefulness are called into use. Most important of his responsibilities are the layout of the process flow-sheet based on material and heat balances, followed by design or selection of the necessary equipment and the proper materials of construction through the testing and experimental operation of the pilot plant and, finally, through the transition to full-scale production.

ECONOMIC RESEARCH

Very early in the development of any chemical product or process, someone must answer to management's satisfaction several simple but soul-searching questions, such as: "Is it feasible? Can it be made commercially? About what will it cost? Where and how much of it can be sold?"

This preliminary appraisal of a research project is often a chemical engineering function and responsibility. It has been pointed out by Perry[4] that a competent chemical engineer of broad experience and sound business judgment can often do more to promote the economical development of new products than almost anyone else in an industrial organization. In some of the larger chemical companies, feasibility studies are made by a separate division of the development department devoted to chemical engineering economics.

It would be a mistake, however, to imply that feasibility studies are confined to any preliminary stage of research or development work. As a matter of fact, much of the work of the chemical engineer in the pilot plant is concerned with the feasibility of equipment and processes as determined by comparative yields, performance, and cost. Economic balance also enters into the selection of proper materials of construction to resist corrosion, heat or abrasion, and of adequate packaging and shipping containers.

In recent years many of the scientific principles and practices long applied to research and production have been extended into the field of marketing and distribution. As a result, there has been an increase in demand for chemical engineers in sales development work. Market analyses and sales studies designed to find new outlets for new or existing products are being made constantly by well staffed departments in many companies. Closely allied with men in such departments are employees engaged in customer research or in technical service. Market analyses may seem somewhat remote from chemical engineering, yet much of the success of chemical industry in recent years has resulted from the fact that its research has been conducted on an engineering

basis from the first selection of the project to the final utilization of the product in the plant of the customer.

WHAT LIES AHEAD?

Despite the remarkable progress that has been made in the application of chemistry in industry, through modern chemical engineering developments, much remains to be done. Our present knowledge of the theoretical principles underlying many of the unit operations is fragmentary and far from satisfactory. Even our empirical knowledge, painfully gained through costly trial and error, often proves entirely inadequate because we lack quantitative measures of performance under varying conditions. From the standpoint of theory, there is a better understanding of the underlying thermodynamics and reaction kinetics of many of the unit chemical processes; yet in practice the yields obtained in many organic chemical industries are still pitifully low. More fundamental research is sorely needed if these industries are to reach the same high level of chemical engineering efficiency that is common in many of the inorganic fields.

A symposium on "Unit Operations Appraisals," published in 1934,[5] included a series of technical "balance sheets" in which the known assets of fundamental data were set down alongside of corresponding liabilities. For heat transfer, flow of fluids, distillation, evaporation, and drying, there was an impressive array of facts and figures on the assets side, balanced against somewhat fewer but still serious liabilities. In the case of mixing and agitation, absorption and adsorption, filtration and other mechanical separations, there was an over-balancing list of liabilities — of facts and data yet needed to give a true understanding of underlying theory. Some progress has been made by chemical engineers in transferring such liabilities into assets during the past six years, but there are still too many gaps existing in our theoretical knowledge of the unit operations.

Apart from this fundamental study that is so necessary and important, there is still a great opportunity for future rewards to those who will carry chemical engineering research and development into the older industries that have been slow to accept this relatively new technology. Food-processing, leather and textile operations represent promising fields for this type of cultivation. The transformation that has been effected in petroleum refining and coal processing, for example, can be duplicated in certain other industries, once their problems are subjected to sound research and the results applied through efficient engineering developments. In this process, the chemical engineer is destined to play an increasingly important role. The late John Hays Hammond expressed this view in these words:[6]

> Chemical engineering, more than any other, may be called the engineering of the future. . . . The chemical engineer stands today on the threshold of a vast virgin realm; in it lie the secrets of life and prosperity for mankind in the future of the world.

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Courtesy Du Pont

Courtesy McLaughlin Air Service

The tremendous growth of industrial chemical research in this country is well illustrated by E. I. du Pont de Nemours & Co. Above is shown the old saltpeter refinery, a portion of which was erected about 1802, in one corner of which research on refining saltpeter was carried out by one or two men, probably by E. I. du Pont himself. On the right is an aerial view of the present Experimental Station, established in 1904, which has over 800 employees, including many chemical engineers. This company now has some 59 laboratories, including 28 devoted exclusively to industrial research

Research Budgets Highest in Chemical Companies

ROBERT L. LUND
Lambert Pharmacal Co., St. Louis, Mo.

Chem. & Met. INTERPRETATION

Chemical industry ranks above all others in percentage of gross sales income invested in research, a recent survey* by the National Association of Manufacturers revealed. The median expenditure for chemical companies was 3.5 percent of gross sales income as compared to two percent for all industries.—*Editors.*

RESEARCH BUDGETS of 28 chemical companies recently surveyed by the National Association of Manufacturers ranged from 0.6 percent to 12.5 percent of gross sales income. As in all industries studied, there was a tendency for percentages to be highest in small companies and lowest in large companies. The smallest chemical company reported capitalization of $20,000 and 10 percent of gross sales income as its research expenditure. The second smallest, with a capitalization of $50,000, reported an expenditure of eight percent.

In all industries, the median expenditure for companies with capitalizations of less than $75,000 was five percent of gross income whereas the percentage for companies with capitalizations over $50 million was less than one percent. Only one out of seven companies capitalized at $100 million or more reported an expenditure of more than five percent, whereas ten out of 31 companies capitalized at less than half a million dollars reported spending five or more percent of gross sales income for research. The sample represents approximately eight percent of all companies known to have laboratories, but the inverse relationship of percentages of gross sales income spent for research to capitalization and the relationship of expenditures to type of industry is probably representative.

An expenditure of two percent of gross sales income for research by all industry would amount to $1.2 billion a year, based on the Census of Manufactures' 1937 estimate of $60.2 billion as gross sales for all manufacturing industries. This would be four or five times the present expenditures for research.

Of a total of 892 responses, 203 gave information on research expenditures but data from 42 were not usable. About 700 companies reported that they had no laboratories, made no specific appropriations for research or for various other reasons could not report expenditures in relation to gross sales.

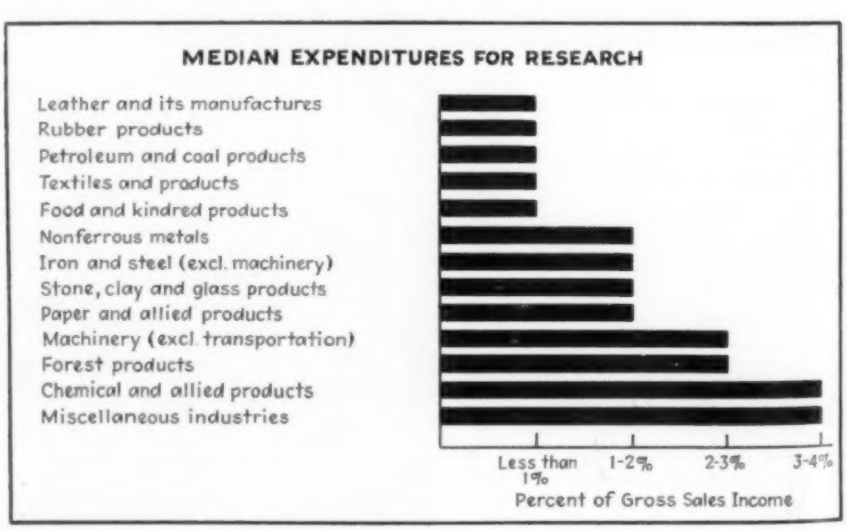
Industrial management has shown keen interest in N.A.M.'s program of stimulating research activities. In many companies, little thought has been given to research and there is widespread belief that small companies cannot engage in research activities. The fact is that no company is too small to conduct research.

In some instances, companies would not be justified in establishing costly laboratories, but there are opportunities for research in every company's field which can be profitably undertaken. Among the methods of moving in the right direction when the expenditure for a laboratory is not justified are:

1. Engaging the services of private laboratories or engineering consultants.
2. Hiring a young engineer or scientist and giving him a relatively free hand to study the company's products, processes and technical problems.
3. Providing a fellowship at a university for a graduate student to study some specific problem.
4. Engaging the services of a research foundation where many trained scientists are available to apply their talents to a company's needs.
5. Obtaining the services of a trade association, equipped to carry on research in the company's particular field.

Affiliated with N.A.M. are 113 manufacturing trade associations who form part of the membership of the National Industrial Council. It was found that 35 of these conduct research activities. Eleven have their own laboratories or cooperate with others in supporting laboratories. The average annual research budget of 27 associations reporting specific figures was $36,960. The median budget was $25,000. Two associations spend more than $100,000 a year. Twenty-one of the associations finance research projects for their members at universities, seven at research foundations and three at commercial laboratories.

It is my firm conviction, and it is a part of the N.A.M. philosophy, that opportunities for progress through research are unlimited, and that we are today on the threshold of an era in which inventions and discoveries surpassing the phenomenal progress of the past will be achieved. The chemical industry will unquestionably grow not only in importance but in relative importance in the industrial progress of the future, and that growth will be due to the spirit which motivates research.



*Directed by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, under the sponsorship of the Committee on Patents and Research.

Making Cane Sugar for Refining

G. L. PACE *General Manager, Iberia Sugar Cooperative, New Iberia, La.*

Chem. & Met. INTERPRETATION

The raw sugar industry little known among chemical engineers in this country, outside of Louisiana and Florida is never-the-less a process industry in which many of the unit operations play an important role, crushing, grinding, maceration, filtration, evaporation, crystallization, centrifuging. The industry, as exemplified by the Louisiana mill described in this article by its general manager, Mr. Pace, is modern throughout, incorporating many new design features and using stainless steels wherever necessary to resist corrosion of the cane juice and abrasion of foreign matter in the juice.—*Editors.*

Most chemical engineers are probably much better acquainted with the refining of cane sugar than they are with the production of the so-called raw sugar. This is no doubt due to the fact that as far as the Continental United States is concerned "sugar making" is limited to two of the most southern states, Louisiana and Florida. And yet it is one of the most important industries in those Gulf Coast areas: in Louisiana alone there are 72 mills devoted entirely to the making of raw sugar.

While it is long established, the industry has kept pace with modern developments as is exemplified by the most recently constructed of the mills, the Iberia Suger Cooperative, Inc., at New Iberia, La., in the heart of the "sugar bowl." Features of this modern mill include high recovery, ample surge capacity, and high fuel economy. All piping over 2 in. is fabricated with seamless welded fittings and welded neck flanges. Lines carrying hot liquors and steam are insulated and all pipe lines are painted with key colors to distinguish live steam, exhaust steam, hot water, cold water, and the various liquors. Gear motors are extensively used although chain drives and pulleys are also to be found in this modern cane mill. The latest developments in temperature control and recording instruments were specified. Many design features which were not obtainable for mills previously constructed were included such as high roll speed and greater pressures on the top roll of the mills. Stainless steel was used wherever necessary to resist corrosion of the cane juice and abrasion by the sand and dirt in the juice.

This mill and much of the equipment were designed and built by Geo. L. Squier Mfg. Co. of Buffalo, N. Y. Their engineers had the collaboration of E. A. Rose, Inc., consulting engineers of New Orleans, La.

As a general rule the raw sugar mills are operated by a planter in order to process the cane of his own plantation. The Iberia plant differs in that, as its name suggests, it handles the crops of a number of planters who are the stockholders in the company. This Cooperative mill has given the small planter an opportunity for the first time to have a voice in the management of the mill handling his cane. The practice of combining the interest of the planter and the mill has worked to the advantage of both. Such an arrangement makes it possible to properly control the flow of the incoming cane, checking the maturity of each plantation owned by members of the organization, and arranging for cutting in sequence and for delivery to the mill. Careful handling of the crop simplifies the rotation of employees required for harvesting the cane and reduces costs of transportation inasmuch as one fleet of trucks suffices to convey the crops of all farmers to the mill. The cooperative plan is said to have been particularly advantageous in the case of a recent serious freeze which occurred during the grinding season. Much of the cane was saved by the careful organization which would otherwise have been lost.

When selecting the plant site the deciding factor was ease of transportation of the cane and the finished product, brown sugar. The location chosen is on the shore of the Bayou Teche which empties into the Gulf of Mexico and connects with the Intracoastal Canal, making it convenient to receive cane by barge and ship sugar by steamboat. Two spurs from the Missouri Pacific Railroad are used for delivering cane and carrying away sugar. Situated as it is on the Spanish Trail, a concrete highway crossing the State gives assurance of splendid roads for trucking cane and sugar.

Cane is brought to the mill throughout the daylight hours and unloaded by two derricks either directly onto carrier feeding tables or stored nearby in the receiving yard. In this way, sufficient cane is stored to assure continuous operation during the night. A diesel operated caterpillar tractor crane is also fitted on occasion for hoisting cane, and acts as general utility to assure prompt release of cars and trucks and assists the transportation system to operate smoothly during peak delivery periods.

Scales for weighing cane brought in trucks and in railroad cars are housed nearby. Both scales are equipped with recording mechanisms and are carefully keyed with the chemical control of the mill. While a load of cane is being weighed, samples are taken and sent to the laboratory. By the time the cane reaches the loading platform, the sucrose content has been determined and the payment (on the basis of weight and sucrose content) has been determined.

Individual steel tables feed cane onto the carriers. The tables are controlled from the operator's house overlooking both platforms and containing the motor controls to regulate the feed on the cane carriers. Attached to the carrier is a set of knives mounted on self-aligning bear-

ings in a heavy steel plate housing. These knives chop the cane into pieces resembling chips, thus preparing the cane for efficient milling. The chips are carried on overlapping steel flights to the crusher.

The heart of the raw sugar factory is the milling unit, for its operation is a large factor in determining the efficient operation of the plant. The cane mill consists of a high speed, heavy duty crusher. It has two toothed rollers, 36 in. in diameter and 66 in. in length, which disintegrate the cane and express about 75 percent of the juice. The lower rolls have juice grooves 1¾ in. deep.

The crusher is followed by a series of four mills of three rollers, each of 34 in. diameter and 66 in. length. These mills continue the operation of extracting the juice until about 94 percent of the sucrose in the cane has been removed, leaving a moist residue called bagasse which may be burned under the boilers. The upper roll of the crusher and the top roll of each of the milling units exerts 500 tons of hydraulic pressure to rupture the cells of the fiber and to express the sucrose containing juice. The mills have been so designed that they can be quickly and easily opened by removing the upper section of housing without removing the intermediate carriers. These mills can handle over 100 tons per hour at a speed of 40 ft. per min.

MACERATION

In order to obtain the maximum amount of juice maceration is carried out. At the last three mills the cane is sprayed with water to facilitate extraction of the remaining juices. Warm water is sprayed on the blanket of fiber in front of the fourth mill in order to mix with the sucrose contained in the ruptured cells, and the mixture is partially expressed in the following mill. The diluted juice from this mill is applied as maceration juice ahead of the third mill, and the diluted juice from this mill is applied ahead of the second and last mill. This method greatly increases the extraction of sucrose from the cane, without adding an excessive volume of water. The resulting juice has a density of about 12.6 deg. Brix.

The cane mill is driven by a set of double reduction spur gearing by heavy duty Corliss engines. One engine drives the crusher and first mill and the other engine drives the last three mills. All gears are enclosed with welded steel casings. They are designed to operate with an

Derricks transfer cane from trucks and railroad cars to steel tables feeding cane carriers

inlet pressure of 125 lb., 0 deg. superheat and exhaust at a back pressure of 10-12 lb. This exhaust steam is used for juice heating and evaporation.

The mills are served by Munson air hydraulic accumulators, and an automatic, electric driven air compressor maintains proper air pressure. A forced feed, high pressure grease system was installed to provide continuous lubrication on both mills and gearing.

The raw juice expressed by the mills flows from the several compartments of the trough beneath the mills to the strainer where small particles of bagasse are removed. This foreign material is returned to the mills by a trash elevator in the usual manner. The screened juice is then pumped to scales where a careful check of the weight of the juice is maintained. The scales, located on the upper floor, are equipped with ticket punching devices and comprise double tanks which are filled alternately by the raw juice pumps.

The juice is next limed in tanks supplied with agitators. Milk of lime is added to raise the pH value to a point which has been pre-determined as being the best for flocculating and settling.

Juice and maceration liquor are handled by stainless steel pumps, which have stainless steel bodies, runners and shafts, and are of the double suction, split shell, motor driven type.

After treating the juice with lime it is heated to a temperature of about 220 deg. F. before passing to the settler. The three heaters have welded steel bodies, provided with expansion joints. The tubes are of copper rolled into steel tube sheets. End covers are hinged to facilitate cleaning. The piping is so arranged that any two heaters may be operated in series and the third may be cut out for cleaning. An automatic temperature control value regulates the steam to the heaters.

The hot juice limed to the suitable pH is pumped into the continuous clarifier, a large tank, and allowed to settle. Here the combination of heat and lime purifies the juice, coagulates the albumin causing the residue to settle to the bottom and the lighter impurities to rise to the top as scum.

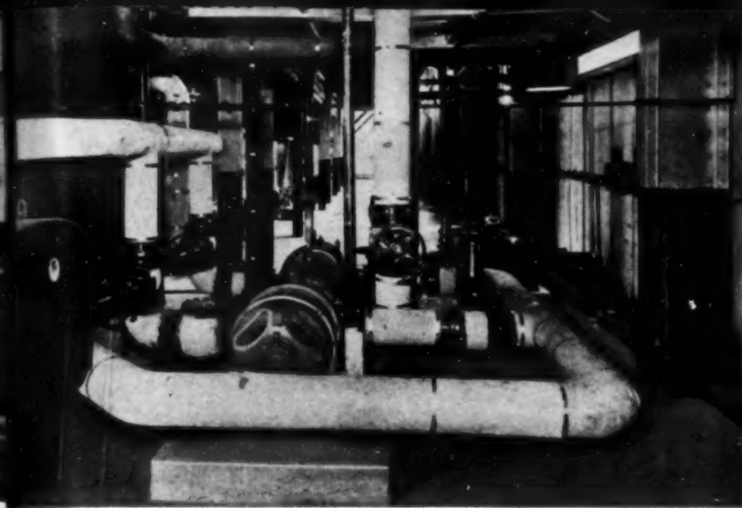
Clear juice passes to the evaporator supply tank, and the muds are pumped to the filter station where they are mixed with the finest particles of bagasse, then fed to the filter. The filter is a continuous vacuum filter where the juice is recovered from the muds and the mud cake is washed to remove available sucrose. The clear juice and wash are then returned to the process. Spent muds are mixed with water and pumped out to the cane fields where they are used as fertilizer.

EVAPORATION

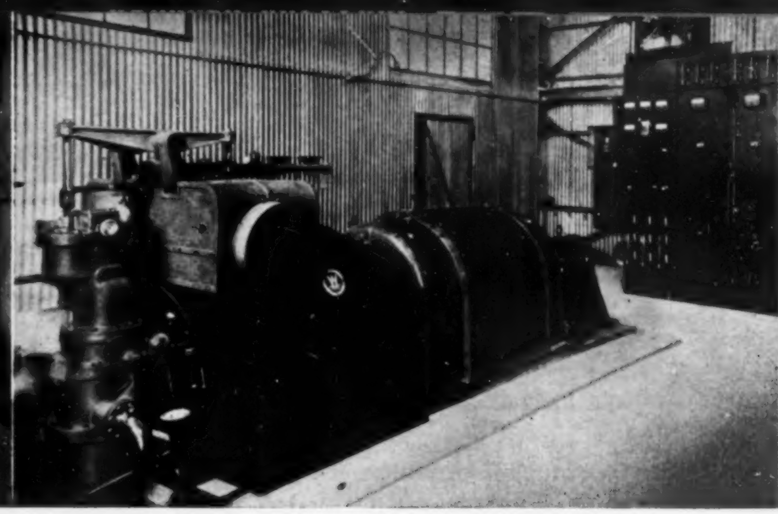
The clear juices are pumped to a quadruple effect evaporator 10 ft. in diameter having 16,720 sq. ft. of heating surface in the four effects. The bodies are cast iron, tube sheets and tubes are copper. The evaporator is served by a counter-current barometric condenser.

The juice enters the evaporators at a density of about 13 deg. Brix (7.24 deg. Be) and leaves at about 60 deg. to 65 deg. Brix (33 deg. to 35 deg. Be).

The syrup is then pumped to vacuum pans. Each pan is 11 ft. in diameter and has a capacity of 1,800 sq. ft. The bodies of the pans are of welded Toncan iron construction with tube sheets and down-takes made of the same metal. Toncan iron tubes are rolled into the tube sheets. Each pan is served by a counter-current barometric condenser of welded construction. The vacuum pans concentrate the evaporator



Motor driven boiler feed pump. Condensate from factory is used for feeding boilers



The turbine supplies exhaust steam at 12 lb. back pressure for juice heating and evaporation

syrups to 90-95 deg. Brix and this semi-liquid, containing a large percentage of crystals, is known as "massecuite."

CRYSTALLATION

There are eight 1,100 cu. ft., water cooled "U" type crystallizers for processing the massecuite before purging in the centrifugals. Here the strikes of the first sugar pan are stored until ready to be sent to the centrifugal mixer. The strikes of the lower grade pans are cooled slowly from 140-160 deg. F. to about 95 deg. F. Then the temperature is raised to about 140 deg. F. just before entering the centrifugal mixer. Raising the temperature helps to reduce the viscosity of the molasses and allows better purging in the centrifugals.

Each crystallizer is equipped with cooling coils; a ninth seed crystallizer is located on the pan floor. They are driven from a line shaft, and are mounted above the centrifugal mixers. A system of troughs permits the passing of massecuite to any of the crystallizers from any of the pans, or directly to the centrifugal mixer, as may be desirable.

For purging the sugar, there is a battery of ten centrifugals, four for first sugars and the balance for low grades. The baskets are 40 in. in diameter by 24 in. deep. The ten machines are driven from a back countershaft with clutches for controlling each unit. A 150 hp. motor drives the battery.

The sugar resulting from a first strike runs between 96-97 percent sucrose and passes directly to the bagging station. This is the commonly known raw sugar and will be sold to the large refineries for further processing. The syrup thrown off the sugar by centrifugal force has a density of about 63 deg. Brix and contains about 35 percent sucrose. This is a comparatively rich syrup and passes to the pan supply tanks where it is used with evaporator syrup to make up first strikes, for the vacuum pans.

The sugar resulting from a second sugar strike might be washed enough to pass to the first sugar bin, if not, it would be mingled with a high grade molasses to form a vacuum pan charge. The syrup from the second sugar machines is called a high grade molasses, has a density of 63 deg. Brix, and contains about 26 percent sucrose.

The sugar resulting from a third sugar strike is mingled with syrup or high grade molasses to be used for seeding the vacuum pans. The run-off is the final molasses and has a density of about 90 deg. Brix and contains about 27.5 percent sucrose. This is sold as commercial molasses.

CENTRIFUGING

The centrifugals are located on the first floor mezzanine. They contain 40 in. diameter baskets and are designed for starting and stopping quickly. This location was selected for the centrifugals so that the conveyors, troughs, and pumps used with them would be above the floor level in order to eliminate objectionable pits and to make it easy to washdown the floor and machines.

There are four 3-drum bent tube boilers, each having 6,360 sq. ft. of heating surface. These boilers are equipped with specially designed hearth furnaces for burning the bagasse refuse which is brought from the mill by the bagasse carrier. An efficient plant with at least 11 percent fiber in the cane, can operate using only bagasse as fuel except when starting. The Iberia plant goes further than this by having an excess of bagasse. Since the initial installation, the Iberia plant has changed its method of operation. It now sells all its bagasse to the Celotex Co. near New Orleans and uses the plentiful Louisiana natural gas in the boilers.

Hot water for the macerating operation and for other process uses is piped from an enclosed tank, equipped with a steam ejector for heating, containing water from hot condensates from the evaporating and heating units of the plant and the overflow from the boiler feed tank.

All the power for the motors of the factory as well as the lighting load is supplied by a 750 kw. non-condensing turbine driven generator. The turbine supplies exhaust steam at 12 lb. back pressure, for juice heating and evaporation.

The switchboard is made up of a generator and exciter control panel, a voltage regulator, five power feeder panels, lighting transformers, a lighting panel and a connection for introducing outside power during the off season.

The office building houses the administrative and clerical staffs as well as the chemical control laboratory. The main plant building is in the form of a "T". The mill room and boiler room are continuous to allow the cane to enter at one end, grind it in the mill and then convey the bagasse to the boilers for burning. The higher section of the building, which forms the leg of the T is the boiling house where the juice is processed.

Buildings are of structural steel with corrugated sides and steel frame windows. The boiling house is three stories high, with mezzanine floors between each story, and with all of the floors and mezzanines of concrete, giving fireproof construction.

For greater detail see:
Electric Power Equipment of the New Iberia Factory by C. W. Drake, *Facts About Sugar*, Oct. 1938.
Iberia Sugar Cooperative Mill, *Facts About Sugar*, Oct. 1938.
Louisiana Cane + Correct Piping Equipment = Quality Sugar, by J. V. Dugan, Jr., *Valve World*, May-June 1940.

Filtration of Granular Materials

A. J. BARNEBL *Filtration Engineer, Swenson Evaporator Co., Harvey, Ill.*

Chem. & Met. INTERPRETATION

Not much information of practical value has been published on filtration, particularly with respect to the filtering of granular materials which differ considerably in filtering characteristics from other sorts of solids. After mentioning use of drainage, classification and centrifugal separation for dewatering, the author discusses in detail types of filters, including the salt type, Dorrco, and top-feed, especially developed for this service. A considerable part of the article is devoted to design of the top-feed filter, and to its application as a combined filtering and drying machine.—*Editors.*

LITERATURE covering the practical aspects of filtration is not very extensive and its deficiencies are particularly notable in the case of that type of filtration which deals with granular solids such as salt, sugar, glauber salt, anhydrous sodium sulphate, epsom salt, potassium chloride, copperas, fine coal, ore concentrates, sand and similar materials. Such materials as these filter so rapidly that the filtering rate may be considered constant within the entire range of practical cake thicknesses.

The cake is so porous that the vacuum in the filter drum is comparatively low and the pressure drop across the combined cake and filter medium is, in itself, insufficient to hold the cake firmly on the filter surface. The holding power must therefore be augmented by the velocity head created by drawing large volumes of air through the cake and this action is principally responsible for the successful operation of the filter.

Another factor in this type of filtration is that the suspended solids settle so rapidly that the handling of the magma and the maintenance of a uniform suspension to insure uniform cake formation are problems of major importance.

Although it is the purpose of this article to discuss the dewatering and drying of granular materials with rotary vacuum and top-feed filters, it should be mentioned in passing that other types of equipment are also being successfully used for the purpose. Among these methods are: drainage in piles; classifiers of the Dorr and the Akins types; gravity filters of the Nutsch type; false bottom tanks; and dewatering with either batch, timed-cycle or semicontinuous and continuous centrifugals of the filtering or the solid-bowl type.

EARLY TYPES

Excepting the early Solvay filter, the design and use of which was kept secret and therefore had little bearing on filter development in general, the first vacuum filters to be used for dewatering granular materials were the Hopper Dewaterer introduced by Dr. H. B. Faber and the Oliver sand table. Both of these machines performed very creditably considering that the freeness of the cake was not fully taken into consideration.

However, the first really successful attempt to develop a rotary vacuum filter especially for granular solids was the Oliver salt-type unit, so called because it was first used for separating brine from salt. The outstanding features of this filter were the large V-shaped drainage members which connected the various filter sections to the large discharge ports in the discharge trunnion. The large discharge trunnion made it necessary to use a large valve and outlet connection so that any considerable resistance to flow of the large volume of air was eliminated. Wire cloth was used as the filter medium and this was another step in the right direction. Fig. 1 shows a filter of this type and Fig. 2 shows the generally accepted internal drum construction for filters designed to handle granular solids.

The first Oliver salt-type filters were equipped with brine stream agitators, designed for the recirculation of filtrate through hollow agitator bars and to provide hydraulic as well as mechanical agitation. This device overcame the difficulty of keeping the solids in suspension and assured reasonably uniform cake formation.

In order to facilitate drying, the drum was hooded and steam coils were provided on top of the hood to preheat the air which passed through the filter cake. This was not very effective and a steam shower and trimmer knife were tried. However, all attempts to produce a dry cake on the salt filter were abandoned when the top-feed filter came into use.

The soundness of the engineering principles embodied in the salt-type filter was reflected in the rapid success achieved. The filtration of granular materials was successfully accomplished and opened a new field for filters. It seemed logical, however, that a redesign for better handling of granular solids would overcome the difficulties encountered, and the Dorrco filter was developed for this purpose.

DORRCO PRINCIPLES

This machine is, in effect, a rotary vacuum filter turned inside out, with the filter medium placed on the inside of the drum and the drum itself serving as the feed tank. This feature eliminates the need for agitation since the more rapidly settling coarser solids settle out next to the filter medium and form a porous cake which itself acts as a filter bed for the finer particles.

In addition to the Oliver salt filter and the Dorrco filter, still another design, the top-feed filter, Fig. 3,

was developed for this class of service. Originally, the top-feed filter was introduced for salt filtration with no thought of producing completely dry salt. However, complete drying has since become the main feature of this design.

FILTER CHOICE

As development progresses, each type of equipment is finding fields in which its operation excels, generally not so much because of inherent advantages as because of knowledge gained in that particular field through special efforts in development and application. Thus the question of choice between one of the rotary vacuum filter types (including the Dorrco filter), and the top-feed filter, is not so difficult to answer.

If we bear in mind that all filter drums used in the filtration of granular materials are now being streamlined and designed to handle large volumes of air and that the brine stream agitator is now seldom used because it has been found that better results are obtained by controlling feed density and drum submergence, the only logical choice is as follows:

1. Use the top-feed filter where complete or nearly complete drying is essential, or where the solids are so coarse that they cannot be kept in suspension.

2. Use the rotary vacuum filter where dewatering, or dewatering and washing, are the important factors.

Although the effective filter area on the salt filter is only 70 to 80 percent, as against 80 to 90 percent for the top-feed filter, capacities for either type of filter may be varied over wide limits unless they are governed by washing or drying. In these cases capacities are definitely limited and can be forecast with reasonable accuracy.

Aside from the difficulty with which the solids are kept in uniform suspension in the tank of a rotary vacuum filter, this type of machine has several characteristics which recommend it. There is ample surface available for thorough washing of the cake when this is required. Capacities can be controlled by drum submergence as well as by feed density, and this type of filter is versatile in the amount of cake that may be left on the filter medium to avoid contamination. For example, the scraper may be set ½ in. or more from the drum surface, thereby leaving enough of the filter cake on the drum to absorb any excess liquor which is held in the screens by capillary attraction. Also, a shower pipe can be located under the scraper to wash and clean the filter medium continuously and to aid in avoiding excessive cover blinding. Finally, the entire drum can easily be hooded and equipped with steam showers or heaters to keep the cake hot when this is required, or the hood can be made fully vapor tight when volatile liquids are to be filtered.

Theoretically, the top-feed filter has only good features. In addition to those previously brought out, this filter can handle a much denser feed which insures greater cake porosity and this is important where complete dryness of the filter cake is required. The higher feed density also permits the use of a more open filter medium and this is an essential factor in the elimination of cover blinding when the filter cake is composed of insoluble solids. Easy and effective cleaning of the filter medium is made possible by the use of a shower pipe located just behind the feed.

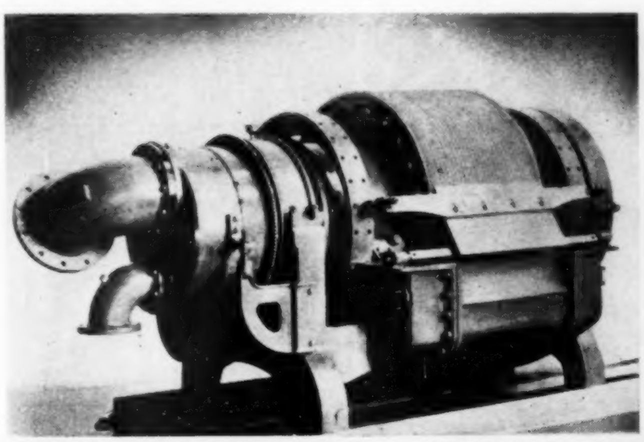
The possible difficulties, which can be minimized by careful design, include trouble in discharging damp filter cakes which tend to hang and build up on the scraper and discharge

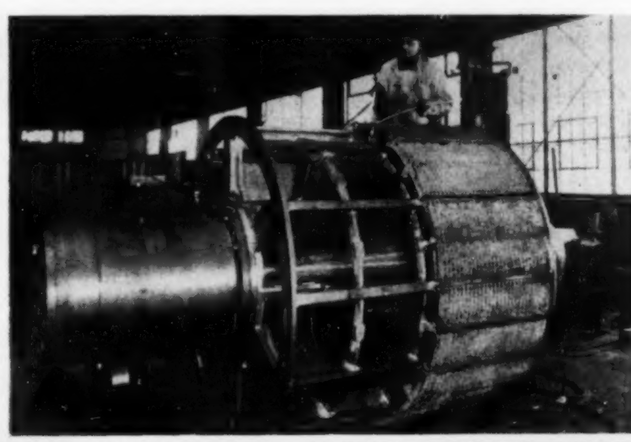
Fig. 1—Oliver salt-type filter has large air and liquor passages, wire cloth filter medium, brine stream agitator

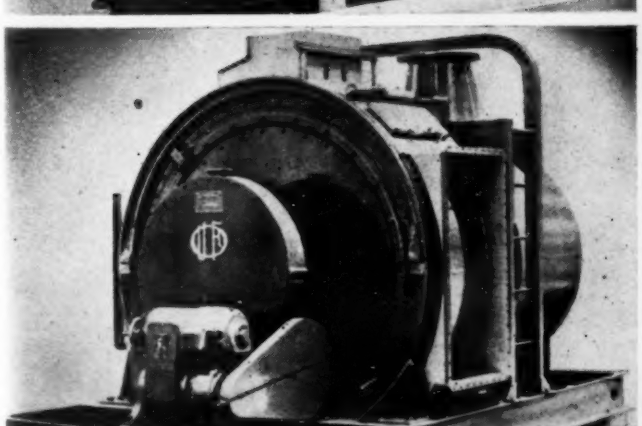
Fig. 2—Swenson salt-type filter drum during construction showing large passages and open grid for drainage

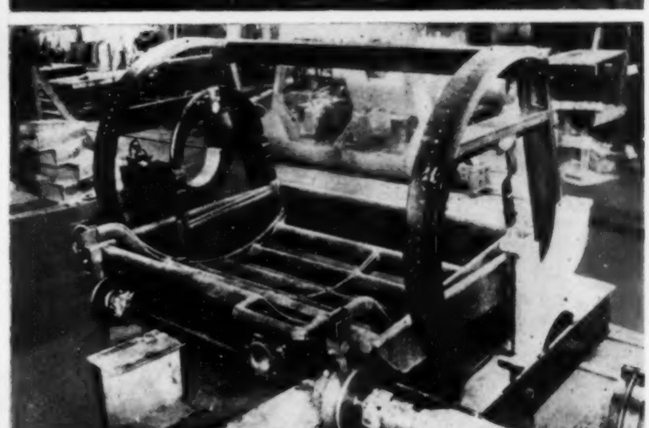
Fig. 3—In the Oliver top-feed filter the drum is inclosed in a hot-air hood except on top where feed is applied

Fig. 4—Swenson swing-type agitator for salt-type filters is suspended independent of trunnions and filter tank









chute; and the difficulty encountered in washing the filter cake because only a small percentage of the total filter area is available for that purpose.

As previously pointed out, the fast settling solids made it difficult to maintain a magma of uniformly suspended mixture in the tank of the rotary vacuum salt filter, resulting in a lumpy filter cake which obviously could not be satisfactorily washed or uniformly dewatered. It was apparent that the logical attack was to improve agitation and the brine stream agitator was developed to solve this problem. However, difficulty was encountered in keeping the spray holes in the agitator open and in maintaining a uniform distribution of the brine through the various outlets.

MAGMA DENSITY

Subsequent work proved that smoothness of cake formation is a function of the magma density, that is, the ratio of suspended solids to liquid in the magma. The magma density is more or less critical for best results; in fact, repeated tests have shown that either a lumpy or a smooth cake can be produced by comparatively slight variations. Unfortunately, the proper density varies with the material being filtered and must be determined in each case, but the range will generally be found somewhere between 15 and 20 percent of suspended solids in the magma, by weight.

Agitator speed, and the clearance between the agitator rakes and the drum surface, have a definite effect on good cake formation, but it has been found that the effect of changes in either case is quite small after a reasonable speed has been reached and the minimum clearance determined. The swing type agitator shown in Fig. 4 can be made sufficiently effective for practically all materials which can be filtered on a salt-type rotary vacuum filter.

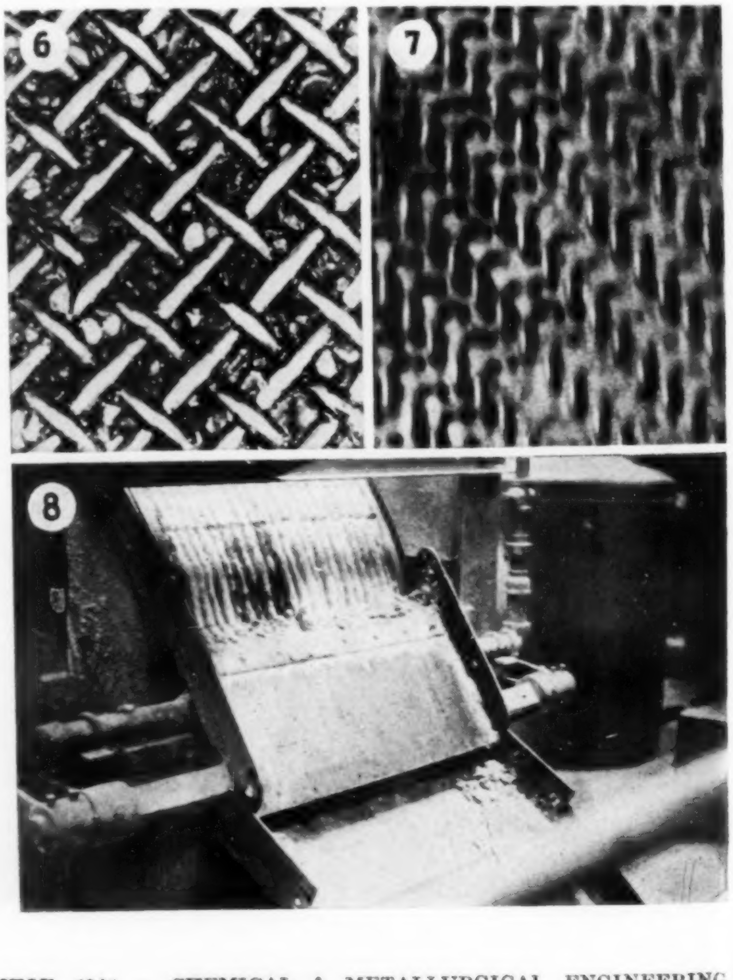
It is evident from the above that it is of major importance to maintain uniform control of the feed density and volume. In order to set up the proper conditions for this control, the feed hopper shown in Fig. 5 was developed and this hopper can readily be applied to any type of filter or other dewatering equipment.

The solids settle quickly to maximum density from the incoming feed and substantially clear liquor overflows. Having a definitely known density to start with, the magma going to the filter can be readily controlled by adding the proper amount of filtrate or water in the discharge nozzle.

FILTER MEDIA

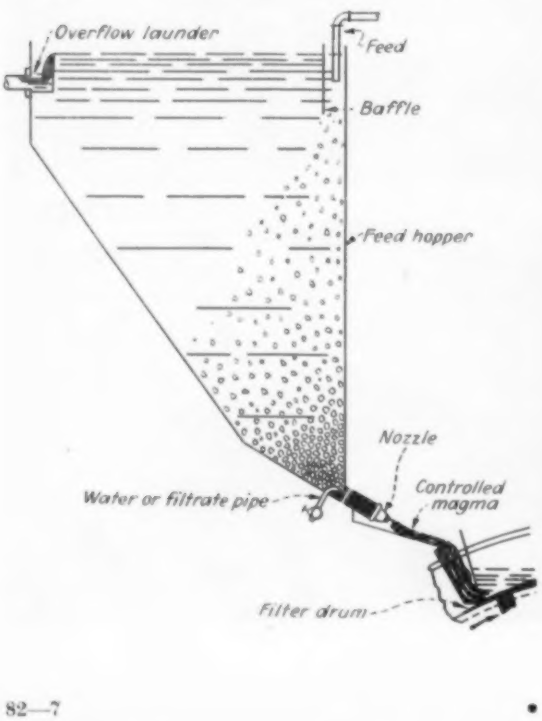
Owing to the severe conditions encountered in the filtration and drying of granular materials, the choice of a filter medium is narrowed down to wire cloth, either rolled or unrolled, and perforated plate. Wire cloth is easily applied, forming a surface without wrinkles or bulges, which takes up expansion and contraction due to temperature variation without excessive warpage. Perforated plate is stiffer and has a smooth surface which simplifies the removal of the filter cake. However, perforated plates warp readily under high temperature conditions and the smooth surface may soon be destroyed and interfere with scraper operation, so wire cloth is normally the medium that is preferred in filtrations of this sort.

Rolled screen has the advantages and disadvantages of both wire cloth and perforated plate. The rolling



Right, Figs. 6-8—(6) Bridging action of particles smaller than screen openings obtained by feeding magma of proper density; (7) Under side of screen, showing how formation of insoluble scale causes blinding, except in open area due to shower impingement; (8) Soap deposition on the screen may cause rapid blinding and the kind of uneven cake formation portrayed in this view

Fig. 5—Cross section of Swenson feed hopper



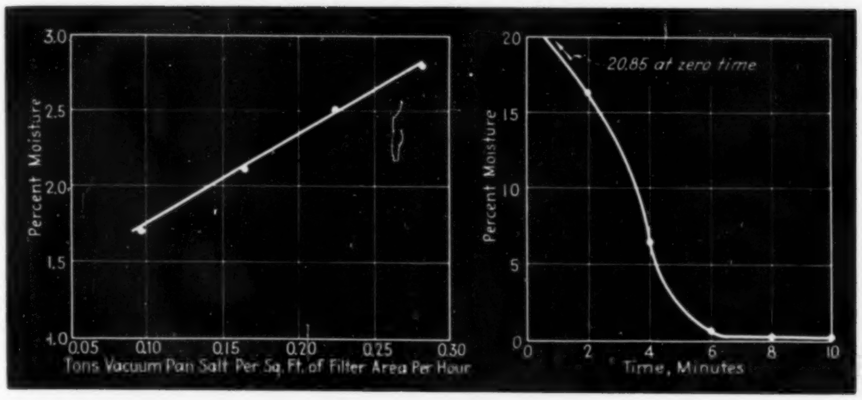


Fig. 9—Effect of filter throughput on cake moisture content when handling vacuum-pan salt on top-feed filter, with constant vacuum at filter valve

Fig. 10—Effect of filter time on cake moisture content when handling crystals similar to sugar at constant air temperature and volume

has a tendency to distort the mesh and the screen as a whole so that it is more difficult to obtain a smooth drum surface. This type of medium does not, as a rule, give enough better results as compared with plain wire cloth to justify its use.

The size of opening in the filter medium is governed by the material to be filtered and the size of the particles in the feed. Fortunately, the trend is toward large openings, allowing the use of heavier wire which gives a longer medium life and better operation. With an open medium, the drainage screen, which is used principally to support the filter medium, can be eliminated by changing the grid design slightly, and it has been found that this construction definitely improves the operation of the filter, mainly because the cleaning is greatly simplified and cover blinding tendencies are minimized.

BLINDING DIFFICULTIES

Blinding of the filter medium may be a serious problem in the filtration of granular material. So long as this type of filtration is confined to soluble salts, such as sodium chloride, it is not difficult to keep the meshes of the screen open by washing with a relatively small amount of water, filtrate or steam, after removal of the filter cake. However, when attempts are made to filter insoluble solids, such as sand or ore concentrates, the screen blinds readily by plugging with particles, unless the openings are substantially larger than the largest article in the feed. With soluble solids, the actual size of openings appears to be of minor importance as long as the total open area is sufficient to permit passage of the required volume of air without undue resistance, and as long as the openings are not so small as to become plugged by insoluble impurities present in the magma.

Fig. 6 illustrates how, through proper control of magma density, the screen openings can be larger than the largest particle in the feed, and still retain the particles. The type of screen blinding which can occur in the case of insoluble impurities present in soluble salts is illustrated in Fig. 7 which shows how a scale of calcium and magnesium carbonates and sulphates forms on the underside of the wires of the filter medium.

Hard water used in the process may be in part responsible for such a condition as this. Use of soft water for washing, if necessary, and avoidance of supersaturation of the impurities in the liquor will help in preventing the difficulty, as will large screen openings and the use of strong showers. Sometimes a weak acid or alkali wash followed by a water wash may have to be used periodically.

There are also a number of other varieties of screen blinding encountered. For example, with anhydrous sodium sulphate, hydration of the crystals takes place upon cooling, if water is present, with the formation of crystals containing various amounts of water of crystallization. The remedy here is to keep the filter cake hot by totally inclosing the filter drum and supplying hot air inside the hood. A somewhat similar case is encountered when double salts are formed, as in the filtration of caustic soda containing sulphate. Again the filter cake should be kept hot and a steam blow may be used to release and discharge the filter cake. A displacement wash with wet steam may also be effective but is not desirable because of possible dilution of the filtrate.

Still another type of blinding may be that caused by soaps formed by chemical reactions, as in Fig. 8. Prevention depends upon the use of an open mesh screen, a strong water shower and a well distributed reverse blow at the discharge.

Moisture remaining in the cake after filtration is an important consideration in most applications. Several factors are involved. Among these is particle size, since the smaller the particle, the greater the total exposed area and therefore the greater the moisture in th cake. Exhauster displacement and the degree of vacuum are important. The higher the air velocity through the filter cake, the more moisture is removed. Since higher velocities are generally coupled with low vacuum and low velocities with high vacuum, the indicated vacuum is a guide to best operating conditions. Filter throughput (which is a compound of drum speed and cake thickness) is also a determining factor, as illustrated in Fig. 9 which shows the approximate cake moisture that can be expected with vacuum pan salt at varying capacities, using an exhauster displacement of .48 cu.ft. per min. per sq.ft. of filter area, with vacuum of 2½ in. Hg at the filter valve.

Effect of time and temperature of filtration on the moisture content is typified in the curve of Fig. 10 for the particular conditions where air at 190 deg.F. and at the rate of 93 cu.ft. per min. per sq.ft. of filter area is being used to dry a cake of crystals similar to sugar and ½ in. thick.

EFFECT OF SOLUBILITY

Finally, the solubility of the salt and the water bound as water of crystallization are determining factors. With a soluble salt, the liquor which adheres to the crystals is a saturated solution from which salt will crystallize on drying. The more soluble the salt, the lower the free moisture in the cake. When hydrated salts are produced, the liquor in the cake comprises a part of the salt, the water of hydration, and free water. In this case a very low free moisture content of the filter cake is generally obtainable. Thus, when complete drying of the filter cake is to be accomplished, the solubility and the stable phases of hydration must be known, as well as the temperatures at which the various changes take place, so that all factors can be properly provided for.

High washing efficiency of the filter cake depends on achieving a uniform porosity which allows the liquor and wash water to pass through rapidly. In such a case suc-

cessive washes can be drawn through the cake completely before the next one is applied, thus insuring exceptionally high washing efficiencies.

Exhauster displacement and the vacuum achieved are a phase of filtration on which few practical data are available. The amount of air that can be drawn through a filter cake and the vacuum which results cannot be predicted accurately except as intelligent guesses based on practical experience. The controlling factors here are particle size, uniformity of grain size, cake thickness, cake moisture and to some extent, the filter drum speed. Fortunately, the positive displacement rotary blowers and centrifugal types used are rather flexible in operation, having wide latitude in speed and capacity.

DRYING

The top-feed filter dries without disturbing the crystals and permits intimate contact of each crystal with the hot air. Some of the liquor is also removed mechanically from the cake owing to the high velocity of the air. Therefore the overall efficiency of the system is greatly increased. However, this added efficiency is somewhat offset by the fact that the filter cake cannot, with equipment as at present designed, be completely removed from the drum, some of the material remaining to be re-wetted and dried a second time. It is difficult to avoid this because the final scraper must be quite rigid, while allowance must be made for expansion of the filter drum under high temperature operating conditions.

HEAT REQUIREMENTS

In analyzing the heat requirements for drying granular materials on a top-feed filter, it is important to have clearly in mind what takes place at various points in the filter cycle. The cycle begins with the feed on top of the drum. It is desirable to employ a magma of maximum possible solids content, consistent with even distribution of the feed. The excess liquor and some of that between the grains is quickly sucked into the filter drum and as soon as this has occurred, the air breaks through. It is important that this break-through should take place uniformly through the entire surface of the drum, thus emphasizing the importance of having a filter cake of uniform porosity and thickness.

Once the air has broken through the cake, evaporation starts. If the feed temperature is approximately at the boiling point of the liquid, there will be a decided cooling effect owing to evaporation, but if the feed temperature is less than the boiling point, as is generally the case, an appreciable temperature rise will take place in the cake. As the liquor temperature rises, there will be an increase or decrease in the solubility of the solids, depending on whether the solubility curve is of the rising or inverse type. In the first case, the amount of dissolved material in the liquor around each grain will be increased, while at the same time the viscosity of the liquor will decrease with the rising temperature and some of the liquor will be removed mechanically by the rapid flow of air through the filter cake. This last effect will also take place in a case of inverse solubility curve, since some of the soluble solids will crystallize, leaving a more dilute liquor around each grain which also contributes to lowering of viscosity with increase in temperature.

Drying of the filter cake is progressive from the outside to the inside and as evaporation ceases in any layer, the temperature of the solids in that layer increases rapidly, making it desirable to remove the successive layers as fast as they are dried. Also, where soluble solids are involved, crystallization of the dissolved material tends to cement the grains together, forming a crust. On this account, intermediate scrapers may be used to remove the dry outer layers but it is preferable to use only one such scraper designed to act as a rake or harrow to break the outer layer.

The major part of the heat is consumed in heating and evaporating the residual water in the filter cake, following initial mechanical dewatering of the solids. This part of the heat includes that used in raising the temperature of the liquid removed mechanically, and also whatever excess heat is supplied to insure complete drying. All of this heat finds its way inside the filter drum, part going to raise the temperature of the filtrate, but most of it being discharged from the system in the air which contains entrained particles of liquor.

WHERE HEAT GOES

A considerable part of the total heat supply goes to heat the solids from the feed to the discharge temperature. Part of the heat is accounted for by radiation losses, part by leakage and the balance by inherent inefficiencies in the heater itself. In a typical case involving the drying of scrubbed foundry sand, the thermal efficiency of the overall operation amounted to 47.7 percent. However, if the heat in the filtrate

(*Please turn to page 92*)

Fig. 11—Typical installation of Swenson top-feed filter, including feed hopper, filter, air heater and booster fan, receiver, exhauster, seal tank

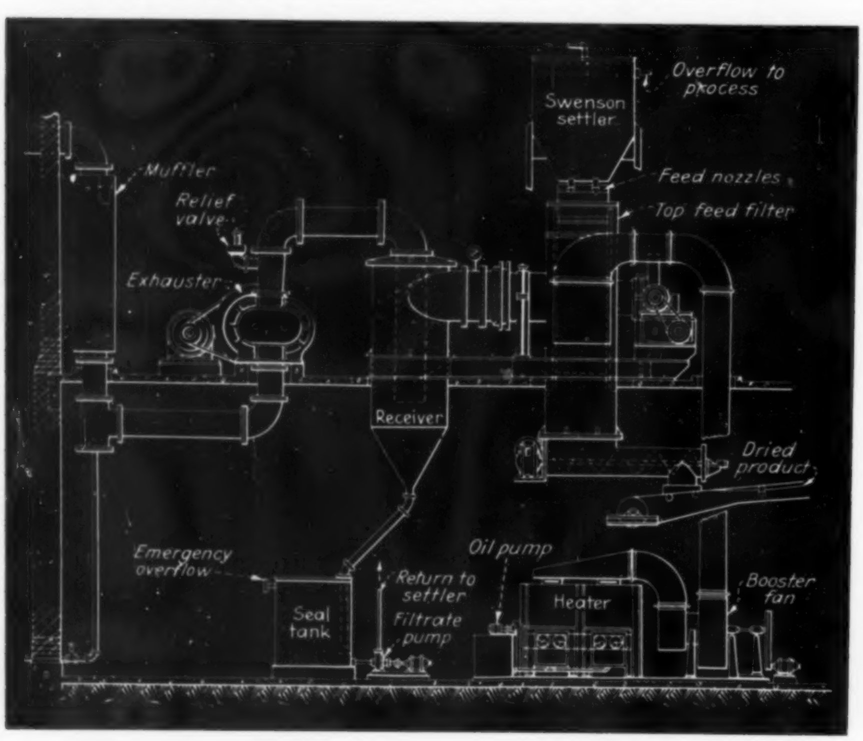


Plate Efficiency Study in Ethyl Alcohol Distillation

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Chem. & Met. INTERPRETATION

This article, which was abstracted by the authors from their recently issued Bulletin 328 of the University of Illinois Engineering Experiment Station, gives results of an investigation of the effect of certain factors on plate efficiencies in the distillation of ethyl alcohol-water mixtures. Factors considered included vapor velocity, liquid rate and composition of the system. A semi-quantitative analysis of the probable effect of viscosity, surface tension and diffusional driving force was also made.— *Editors.*

IMPORTANCE of determining plate efficiencies for the proper design of fractionating columns is widely recognized. This basic problem is, as yet, largely unsolved, because those factors which influence plate efficiency most and which can be analyzed in advance are not well understood. Many investigators have proposed analyses of plate efficiency from theoretical considerations. The factors involved in such derivations are generally not those which can easily be evaluated prior to the construction and operation of the fractionating column.

Some years ago, it was thought advisable that a study be made to determine, if possible, the relationship existing between plate efficiencies and certain definite factors which could be measured or calculated in advance. A concept of the action of the individual bubble-cap plates was proposed,[6] breaking up the fractionating operation into definite steps and postulating that the principal mass transfer through vapor-liquid interfaces occurred during the formation and rupture of vapor bubbles.

The results of many investigations have shown the importance of the "plate factor"—the mechanical design of the bubble-cap plate—particularly in the case of improved bell or slot construction. This and the factors of vapor velocity and liquid rate may be grouped together.

A second set of factors is concerned solely with the liquid system and includes such physical properties as viscosity and surface tension. These factors may have some effect on mass transfer in the vapor phase within the bubbles, but probably of more significance are such factors as diffusivity, partial and total pressures, effective film thickness, and temperature—all of which have an influence on vapor-phase diffusion. Diffusivity, in turn, is a function of relative molecular weights, temperature, pressure, etc.

Considerable work has been done in the past on the effect of vapor velocity (rate of distillation) and liquid rate (reflux ratio) on plate efficiency.[2, 3, 13, 19, 20] The results, however, are not consistent, and the agreement among investigators is not good, even when a single system such as ethyl alcohol and water is used. Several of these investigators have also noted the apparent effect of alcohol concentration on plate efficiency with little agreement.[7, 8, 14, 15] Kirschbaum, probably because of his extensive experimentation, has drawn conclusions most worthy of study.[9] It is only natural that the results thus far reported in the literature are not satisfactory, if they are considered in the light of the experimental difficulties involved. Clear-cut analysis of the problem of fractional distillation, as derived from well-planned experiments, seems almost impossible because of the complex interaction of the many controlling factors.

The purpose of this investigation was to determine the effect of vapor velocity, liquid rate, and composition of the system on the plate efficiency of a bubble-cap column rectifying mixtures of ethyl alcohol and water, and to analyze, on a semi-quantitative basis, the probable influence of viscosity, surface tension, and diffusional driving force. It is the intention of the authors to give here a brief review of the work which has recently been reported in detail in Bulletin No. 328 of the University of Illinois Engineering Experiment Station.*

APPARATUS AND PROCEDURE

The apparatus (Figs. 1 and 2) was essentially a four-plate rectangular column, especially designed for the purposes of this investigation, mounted above a large, horizontal, cylindrical kettle containing steam coils whose heating surface could be varied at will. Auxiliary equipment included a condenser, sight-box, rotameters, reflux heater, and a heating element to prevent partial condensation of the vapor in passing from the column to condenser. The apparatus was also equipped with both vapor and liquid sampling lines which passed through an outside condenser-cooler. Sampling of the vapor entering each plate and leaving the column permitted more accurate calculation of plate efficiencies than the customary computation from liquid

*Limited edition available gratis until exhausted, or until Nov. 15, 1941. Price regularly to be $0.70.

compositions. Vertical partitions were erected between the plates to insure uniformity of vapor flow and to prevent mixing of the vapor and liquid phases except in the vicinity of the single bubble-cap on each plate. The column was operated at rates well below the point of apparent entrainment, as checked by measurements and visual observation.

The range of vapor velocities was 0.2 to 3.0 ft. per second, based on the maximum cross-section of the vapor path, while the reflux ratios used (liquid return to total vapor) were 1:1, 2:3, and 1:2. The overall Murphree plate efficiency[12] based on vapor compositions

$$E_o = \frac{Y_n - Y_{n-1}}{y^*_n - Y_{n-1}}$$

was used in the computation of individual efficiencies. The actual concentration of ethyl alcohol in the vapor phase (Y_n) was determined from analyses of the vapor samples, corrected for the slight enrichment by partial condensation that occurred in the sampling lines. The corresponding "theoretical equilibrium" value (y^*_n) was taken from the equilibrium curve at points corresponding to the concentration of alcohol in the liquid stream (x_n) leaving the same plate. The vapor-liquid equilibrium relationship used for this purpose was taken from Hausbrand's text,[4] because the data presented there seemed the most accurate to be found in the literature. More recently, Langdon[10] (in these laboratories) has redetermined the equilibrium curve for ethyl alcohol and water with still greater precision.

Since it was possible, in this type of column, to obtain overall Murphree efficiencies, E_o, above 100 per cent (because of high concentration gradients in the liquid stream), it was considered worth while to compute local plate efficiencies, E.[11] These values may be derived from overall Murphree efficiencies by the following equation:

$$E = \frac{y_n - Y_{n-1}}{y^*_n - Y_{n-1}} = \frac{R}{m} \ln\left(1 + \frac{m}{R} E_o\right)$$

where R is the reflux ratio (L/V), and m is the slope of the equilibrium curve (dy^*/dx) at a mean value of x_n.

The variation of both overall Murphree and local plate efficiencies with composition of the liquid, for reflux ratios of 2/3 and 1/2, is shown by the data of Figs. 3 and 4. The values of plate efficiency were plotted without regard to vapor velocity which, within experimental precision, had neither an appreciable nor a directing influence. Fig. 3 also shows the variation with liquid composition of viscosity[5] and surface tension[1] of the boiling liquid, and the slope of the vapor-liquid equilibrium curve ($m = dy^*/dx$).[4]

A comparison of Figs. 3 and 4 shows that a rather marked change in reflux ratio has little effect on plate efficiency, although the higher ratio, in general, yields somewhat higher efficiencies. Results of experiments at total reflux are not shown here, since data could not be obtained for low concentrations of alcohol, and the portion of the plate efficiency–liquid composition curve at higher concentrations gives no further information. It may be noted here that experiments at very low distillation rates gave somewhat higher plate efficiencies than those at moderate vapor velocities (below the point of entrainment), but there was in no case a marked and continued variation of efficiency with rate of distillation.

In Figs. 3 and 4 it will be noticed that low efficiencies occur when the concentration of ethyl alcohol is either very low or relatively high. It must be remembered, however, that the calculations of plate efficiencies, particularly in these ranges, are subject to inherently large errors. In the computations the difference between two values which are, generally, of the same magnitude must be divided by another value

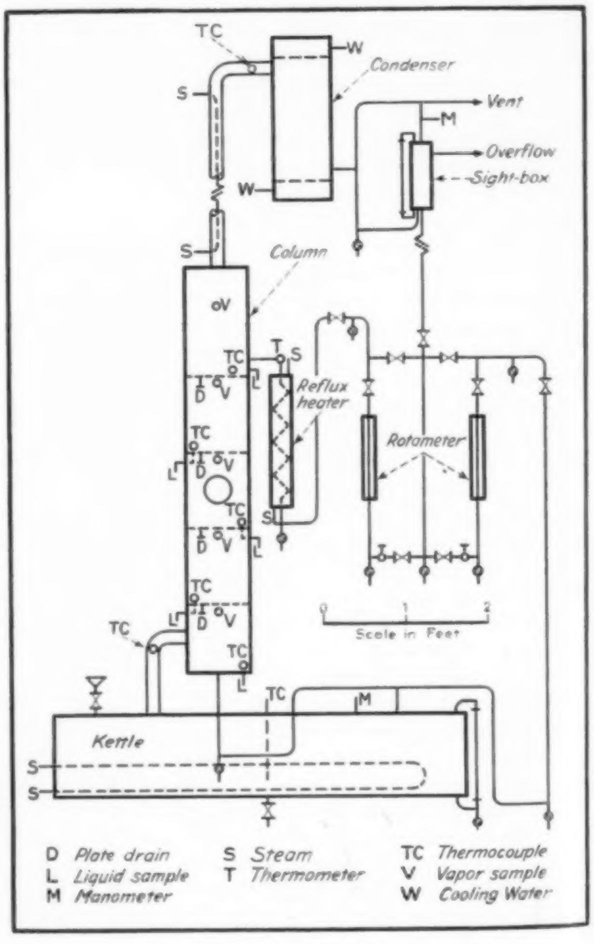
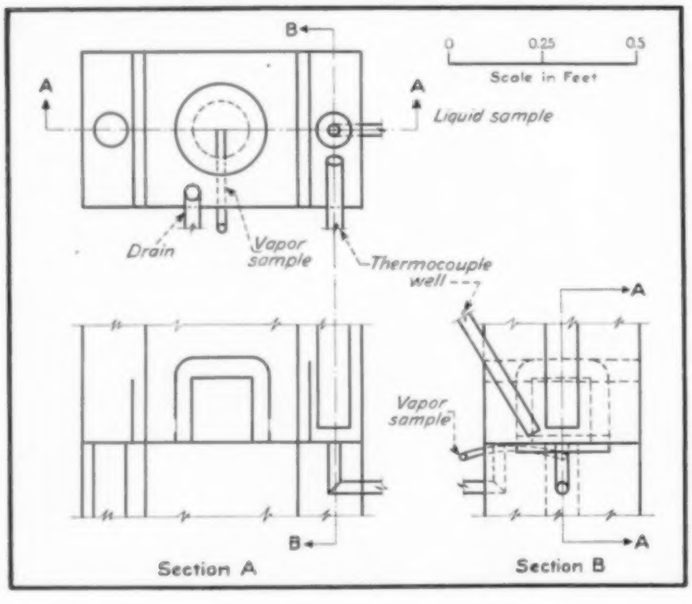


Fig. 1—Assembly of apparatus used in distillation study

Fig. 2. Below—Details of distillation column plate



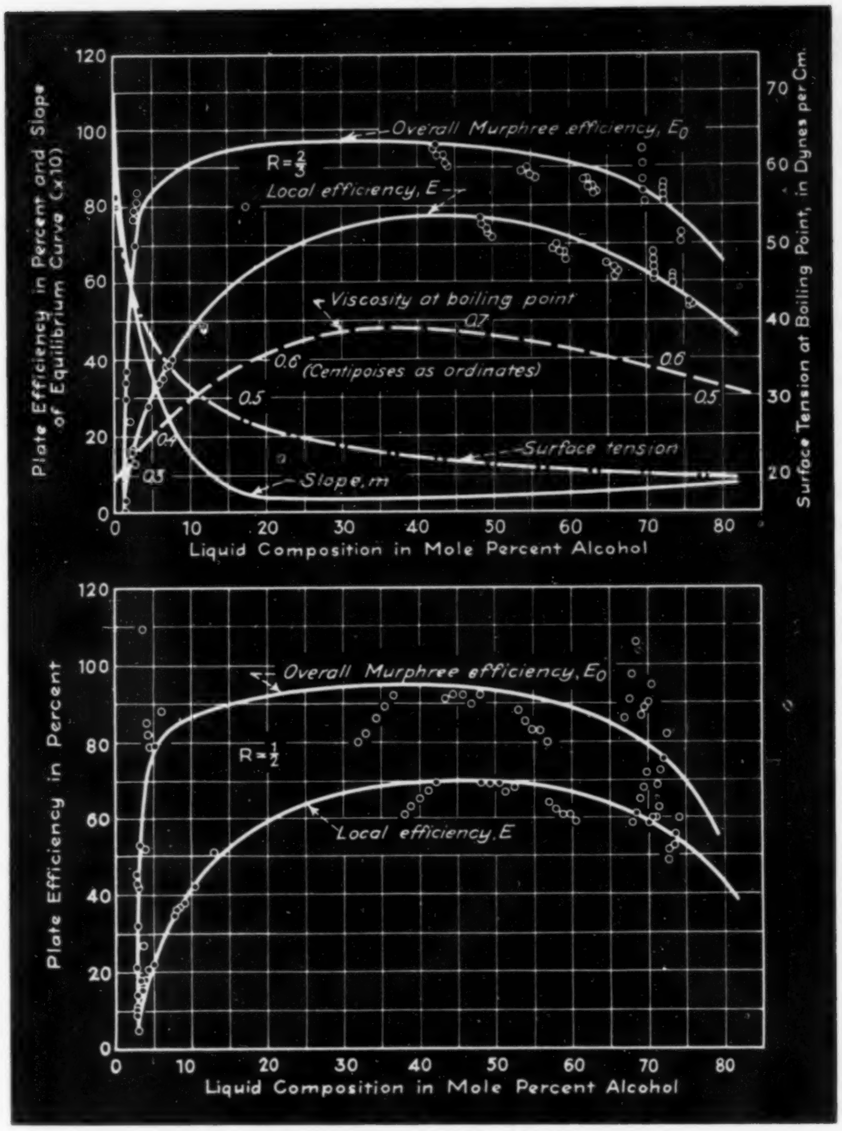


Fig. 3—Plate efficiencies at R = 2/3, and physical properties of mixtures

Fig. 4—Plate efficiencies in ethyl alcohol-water distillation, R = ½

similarly derived. Moreover, a small error in the determination of the vapor–liquid equilibrium relationship in these regions results in a large error in the value for plate efficiency. It is noteworthy that the recent work of Langdon[10] indicates values of the equilibrium curve for ethyl alcohol and water somewhat higher in these ranges than the relationship used,[4] and it is probable that the plate efficiencies have even lower values.

Certain workers in the field of fractional distillation have suggested that plate efficiencies should be affected, in some measure, by the diffusional driving force existing at the point under consideration. It is interesting to note that low efficiencies are found, in the present investigation, at the extremes of the composition range, where the maximum diffusional driving force is small.

The work of Schnurmann[16, 17] has indicated that the size of bubbles, whether formed in a static or a dynamic system, is inversely proportional to the viscosity of the liquid, but is independent of its surface tension; a maximum in the viscosity–composition curve corresponds to a minimum in bubble size—which may be considered to yield the greatest interfacial area for mass transfer. It may be noted here that the viscosity curve for the system used in this investigation (Fig. 3) has a maximum value in approximately the same region of liquid composition as do the plate efficiency curves, while there is no apparent relation between surface tension and plate efficiency. The influence of viscosity is in line with previous assumptions of Sherwood[18] and of Keyes[6] who suggest that most of the mass transfer in bubble-cap operations occurs during the formation and rupture of vapor bubbles, particularly in the region of froth or foam above the agitated liquid on the plate.

In summary, a study has been made of the fractional distillation of ethyl alcohol–water mixtures in a bubble-cap column of four plates, operated without entrainment at superficial vapor velocities of 0.2 to 3.0 ft. per second, and at reflux ratios (L/V) of 1:1, 1:2, and 2:3.

The determination of plate efficiencies by direct computation from compositions of both vapor and liquid samples has been shown to be both experimentally practicable and valuable in theoretical studies.

Both the overall Murphree and the local plate efficiencies, in terms of vapor compositions, vary markedly with liquid composition over its entire range, and have low values at low and at high concentrations of alcohol. Neither plate efficiency is significantly affected by variations in reflux ratio (liquid rate) or in the rate of distillation (vapor velocity).

Graphical comparison has been made between the viscosity–composition relationship and the plate efficiency curves. Maximum plate efficiency for the system, ethyl alcohol–water, is shown to exist in the same region of liquid composition as maximum viscosity.

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Substitution Possibilities and Materials Research

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Chem. & Met. INTERPRETATION

This article is based on a condensation of two talks recently delivered by Col. Brady, one before the National Association of Purchasing Agents at Chicago, in May, the other before a group of chemical market research specialists in Washington, in June. Col. Brady is Chief of the Substitute and Secondary Materials Section of OPACS and so is singularly well placed to know what substitutions can be made for critical materials, and where greater production should be stressed, or new materials developed.—*Editors.*

In the present emergency industry is entering a period, especially in civilian products, when it will have to modify what it makes and sells to conform with the requirements of what is available in the raw materials market. Since substitution and the use of new materials inevitably cause a dislocation and rearrangement of other factors, we must see that our defense industries are supplied as far as possible with materials to which they are accustomed.

More than 100,000 different raw materials go into the processes of a modern industrial nation, their sources scattered over the entire world. No war between two great industrial nations today can exist, therefore, without precipitating the whole world into economic warfare, and it is obvious that our own economy cannot fail to be affected. It is not unusual that shortages, in the light of our defense efforts, should already be pressing. These shortages are of two kinds: those arising in materials which are normally not used in such huge quantities; and those coming from overseas on which the supply has been cut off or reduced because of the ship shortage.

Among chemical shortages of the first kind may be mentioned methanol, formaldehyde, toluol, cresols, nitric acid and nitrogen compounds. In the second class are included vegetable oils, varnish gums, waxes and resins, vegetable and animal fibers, and vegetable drugs. Today we find ourselves hampered by growing deficiencies in hundreds of materials that are vital links in our industrial processes. For the next year, at least, until we can overcome the strangling effects of submarine warfare on shipping, we will be forced to ration supplies of such materials and incorporate substitutes, sometimes with great rapidity.

Before going more specifically into some of the possibilities for substitutions and for development of new materials, I should like to comment on a misconception apparently shared by many people, namely that of the possibility of self-sufficiency for the United States. Recently, at Staunton, Va., President Roosevelt repeated the words of Woodrow Wilson that "democracy cannot exist in isolation." We who deal with materials understand the interdependence of nations in the development of industrial civilization. Nature seems deliberately to have placed materials in such scattered positions on the earth as to compel men to cooperate in the progress of civilization. We can and will obtain more substitutes and new materials from South America, especially from Tropical America, but we will always need materials from Asia, Europe and Africa, and they will need ours.

When I speak here of substitutes, I do not refer to new inventions although, of course, we hope that the course of invention will be quickened. I refer chiefly to rapid changes in materials to replace or prevent shortages. These may be considered to fall in three general classes: substitute materials, alternate materials, and new materials. The first of these includes substances which can be supplied quickly and in sufficient quantity to take the place of the old material, with only a minimum of change in design of product and in processing. Alternate materials, are usually entirely different materials which change the entire manufacturing arrangement of a factory. Finally, new materials are those not formerly in existence. They are usually slow in coming and long in development. The course of invention is invariably slow, and to count on the development of new materials introduces the danger of delay and serious application errors.

A hasty look at the development of several new materials will bear this out. Rubber had been worked on for 70 years before Charles Goodyear discovered vulcanization. Another 70 years followed before the reinforcing properties of carbon black were known. Synthetic finishes were 15 years in development. Plywood was an idea centuries old before the advent of new adhesive materials made it a really practical construction material. Plastics had a background of half a century before they got well in motion.

Plastics should not, however, be considered just as substitute materials, nor as a single material. There are no less than 12 separate groups of plastics, covering a wide range of characteristics, and even now shortages are developing which will affect some of them. Furthermore, many of the changeovers to plastics will involve heavy initial expense when the attempt is made to substitute them for products formerly made from metal. However, many such substitutions will be permanent, since plastics are frequently better.

The greater part of the production of plastics comes from coal-tar materials, and the shortages of phthalic anhydride, cresols and phenol have become acute. These and related materials are of such wide basic importance that direct attention must be given to increased supplies. I go so far as to say that

chemical industry might possibly improve the opportunities offered by this emergency, and change the very nature of the economic and social life of some of our coal regions by establishing modern plants in those districts to give us a better type of prepared fuel and at the same time produce coke, chemicals, drugs, dyes, liquid and gaseous fuels and other products, literally at the mine mouth.

In regard to heavy chemicals such as acids, coal-tar products and nitrogen compounds, these are, of course, primarily defense materials, but still I think I can safely say that it is the general policy of the government to maintain if possible a reasonably liberal supply of every civilian item whose lack would lower the standard of living and react against high morale. The task of industry right now is to produce everything needful that it can possibly produce. I think that we can meet the afterwar problem in an intelligent manner when it comes.

Chemicals that will be needed in greater quantities include industrial alcohol, methanol, acetone, caustic soda, chlorine, formaldehyde, benzol, naphthalene, nitric acid, phthalic anhydide, sulphuric acid and metallic salts. Further than this, problems of supply of the chemicals, oils and waxes used by the leather industry have become important. Closing of the Mediterranean countries to our trade has cut off the supply of Sicilian sumac, valonia and nut galls, and lack of shipping has made it difficult to obtain adequate quantities of gambier, cutch, myrobalans and other materials from the Far East. Still, in the American continents, are vast quantities of oak, hemlock, sumac, larch, algoroba, quebracho, mangrove and other tanning materials with a wide range of properties. In Latin America are various excellent tanning agents that have never been used commercially in the United States. With our chemical skill, today we should be able to produce practically any blend or artificial combination that will give our tanners the results they need.

In like manner, the task before the chemical industry is to meet the deficiencies in oils and waxes with synthetics or blends. The whole complex problem of oils and fats, especially those going into industrial uses in paints, varnishes, lubricants, cutting compounds, fluxes, and general industrial applications might be taken under the wing of the chemical laboratories. Although only on a small scale as yet, some companies are already fractionating fish, animal and vegetable oils, extracting the desired acids and reblending to give definite and constant chemical and physical effects. Two new oils, castor and soy bean, have come into the paint industry because of the possibility of remaking them into drying oils. We can actually improve on nature, and I believe the time will come when oils will be bought, not by the common name of plants, but rather by trade names representing definite uniform physical and chemical properties. And the same may be said of waxes.

In other cases however, building up and rationing of supplies is preferable to the pushing of substitutes. For example, many of our crude drugs are imported from tropical or European countries. The supply of some has been drastically cut. For many of these we have substitutes, but in general these substitutes act differently than the original products, either quantatively or qualitively, and they thus require different techniques of application. Our problem is to locate and ration the supply of natural drugs, to see that cargo space is provided for additional supplies, and to see that speculation is eliminated. The substitutes can then advance naturally.

PROBLEM OF RUBBER

Rubber poses a somewhat different problem. About 77 percent of rubber consumption normally goes into automotive tires and tire accessories, with an even higher percentage today. So far, we have done nothing to cut down the enormous civilian use of rubber for pleasure automobiles. Nevertheless, rubber is at the top of the strategic list. Yet the available rubber substitutes are not direct substitutes, some being better for some purposes, but unsuited for others. Furthermore, there is no substitute at all for rubber in the same price bracket. Even a natural substitute such as guayule will require a long period of further development, and I am told by an expert in the Department of Agriculture that rubber must advance 50 percent more in price before guayule can be considered commercial. Therefore, the immediate problem with natural rubber is to cut non-defense uses.

Substitution for aluminum is a problem in still a different category. The shortage is a serious one, yet aluminum ores are plentiful and once the facilities are brought in, especially large scale power facilities, supplies should be increased. For many of the common civilian uses, almost any metal can be substituted, or a plastic can be used as an alternate. In addition to aluminum, the metal industries needing greatest expansion are magnesium and beryllium. Magnesium production this year is expected to reach 30,000,000 lb. with 50,000,000 in 1942.

An important substitute for copper and aluminum is enamelware. Enamel products now obtainable are highly resistant to food acids and improved processes yield coatings of lesser thickness, reducing chipping.

A phase of substitution that I want to mention is possibility of replacement of materials from the Far East with similar or alternate materials from Latin America. Obviously, a ship plying between the north coast of Brazil and one of our eastern seaports is worth five or six ships from the Far East because of the shorter turn-around. From Brazil can come babassu oil to substitute for cocoanut oil from the Philippines, and oiticica and castor oils to replace tung oil from China. Other possibilities lie in the replacement of jute and manila hemp with caroa and other South American fibers, and East African tapioca and African cocoa beans with their Latin American equivalents.

Still there are problems in such substitutions. Now that shipping shortages from Africa give an opportunity for increased supplies from our near neighbors, we are confronted with a tendency on the part of producers to hold out for higher prices on products that are often of secondary quality. There is much development to be done and probably much careful diplomatic work also before we can talk freely of substitutes from Latin America.

In conclusion, American industry is faced with a long, hard road, and with the need for production at hitherto unheard-of rates. Pooling of information on substitutes is one course that will help. Another is a real joint effort at cooperation on research aimed at increasing production of standard items and obtaining quick substitutes or alternatives for shortages. As yet we are only pioneering in materials creation out of basic atoms, and the outlook for new horizons in the chemical industry is stupendous. Dreams must not be allowed to interfere with the immediate task of production for defense, but the chemical industry will, I believe, find such avenues for progress ahead that it will not need to worry about the future.

Resinoid Equipment in Wartime

DUNCAN CAMPBELL *Edinburgh, Scotland*

Chem. & Met. INTERPRETATION

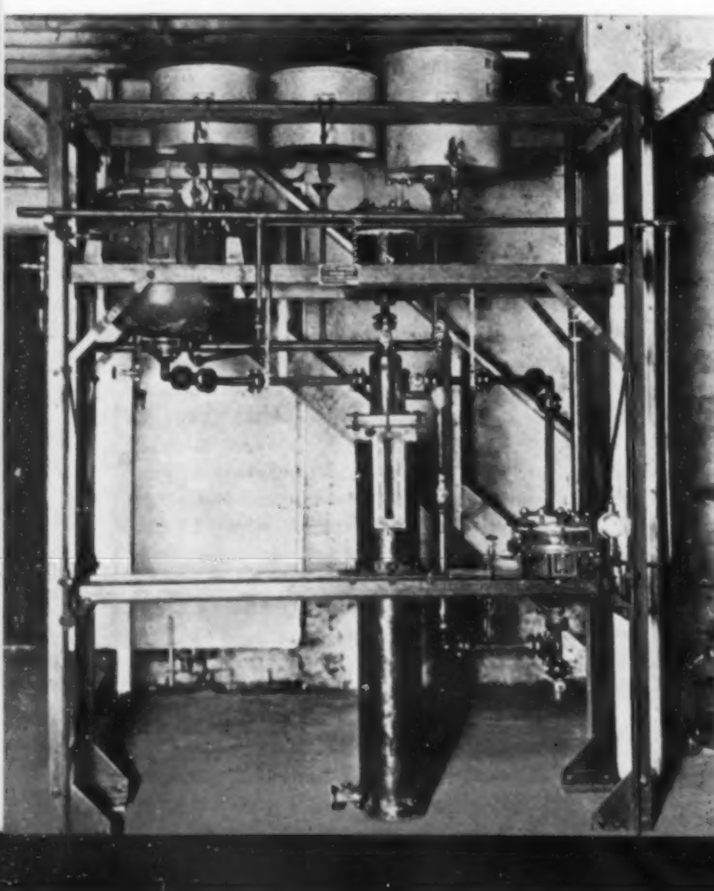
Metals for the construction of chemical engineering equipment are becoming increasingly difficult to obtain. It is, therefore, of interest to learn what has been and is being done in a country which is at war and where the metal shortages are even more acute than they are here. Written by a British engineer under the pseudonym of Duncan Campbell, this article gives some indications of what can be done in the construction of resinoid chemical equipment.—*Editors.*

CHEMICAL INDUSTRY depends for efficiency not only on the use of modern methods and new processes, but also on the materials employed in the construction of its equipment. Corrosion has always been the big bugbear of the chemical plant and has occupied the attention of the technologists for ages past as its avoidance and prevention results in longer life of equipment, in lower maintenance costs and reduced replacement charges. Frequent stoppages for repairs and renewals mean reduced turnover, increased overheads and high costs of production.

Until recently, metals, wood and ceramics have been extensively used in the construction of the chemical plants, but due to corrosion or erosion, their life in service is far from satisfactory. Great progress has been achieved in the past 25 years in developing numerous corrosion-resisting metals and alloys and similar progress is also noticeable with non-metallic materials. Glass and enamel linings in equipment have been used where alloys and stainless steel have failed to give satisfaction but these coatings, despite their superior resistance, can not ordinarily be applied in the field to existing equipment.

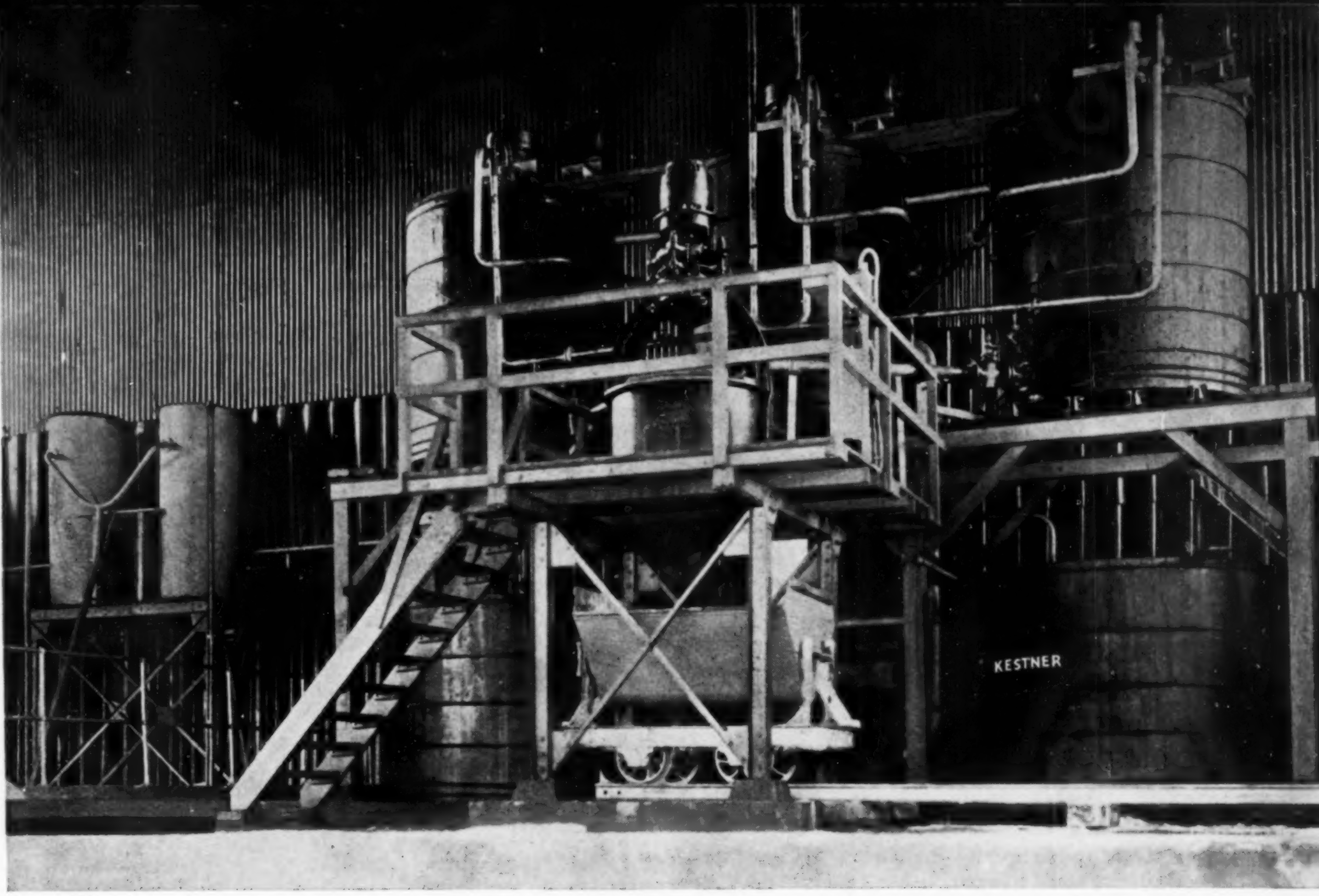
The present war has brought to light many interesting and perplexing problems, notably that of finding *ersatz* for materials normally available during peace-time. For example, there is an acute shortage of all kinds of metals as these now have the priority claim on them for the manufacture of warships, airplanes, guns, shells and such other war materials. Wood, rubber and some other non-metallic materials are also required for war purposes and their supply for other industries is now generally restricted. Stainless steel, aluminum and its alloys, which were employed to a great extent in the construction of the chemical plants, are now exclusively reserved for the manufacture of war equipment and the manufacturers are now obliged to find suitable substitutes to replace these metals. Happily, the plastic industry, which has spent enormous sums of money on research work during peace-time has stepped in to fill the gap with suitable substitutes based mostly on the phenolic resins. It would indeed be difficult to find a better example where the fundamental research carried out by any industry has been more justified and borne such fruitful results.

Benzol recovery installation at the Royal Cancer Hospital, London. The tower, inter-connecting piping and separator vessel are manufactured of resinoid materials



Synthetic resins, especially the phenolics, being inert to chemical attack and having many other useful properties, offer great scope as materials of construction for the chemical plant. These resins, when suitably compounded with fillers, have a tensile strength as high as cast aluminum, but are only half as heavy, having a density between 1.2 to 1.9 as compared with 2.6 of aluminum and 7.2 of grey cast iron. Unlike metals, these resinoids are non-conductors of electricity, have great resilience to absorb mechanical shocks, withstand heat up to 500 deg. F. and are not affected by sudden heat changes and accordingly there is no danger of cracking under even such severe conditions as are involved in sudden temperature change from one extreme to another. Obviously these resinoids are eminently suitable for playing a large and important part in relieving the present abnormal pressure on the metals.

The choice of the plastic material to be used is governed by many factors, such as the maximum temperature likely to be attained in process and concentration of chemicals with which it is to come into contact. For use at higher temperatures, generally one of the phenolics is chosen as these, when properly cured, have no softening point. The properties of the synthetic resins can be varied



Recovery plant for sulphuric pickling acid and ferrous sulphate crystals. The lower tanks are eight ft. in diameter and have a capacity of 1,500 gal. Upper tanks have a diameter of six ft. and a depth of eight ft. and are equipped with stirrers

within wide range by employing phenol, cresol or other higher homologues and each variation produces a different combination of properties. The industry is now so well developed that it can produce resinoid with any desired set of properties to meet the widely varied requirements and demands of the chemical equipment manufacturers.

Phenolic resins are now available which will stand hydrochloric and sulphuric acids (50 percent), brine containing 2 percent sulphuric acid, nitric acid (10–15 percent), ammonium fluoride (60 percent), potassium dichromate (5 percent), sodium carbonate (35 percent), sodium bisulphate (30 percent), sodium chlorate (40 percent), sodium sulphide (50 percent), glycerol, alcohol, acetone, carbon tetrachloride, formaldehyde, gasoline, toluol, xylol and many other solvents and chemicals. Some phenolic resins have been developed to withstand hydrofluoric acid and hydrofluo-silicic acid.

In addition to the manufacture of chemical plants the synthetic resins are also widely used as protective linings for metal and other types of structure against corrosive atmosphere or weather. Coatings based on phenolics are known to have resisted attack by various chemicals for a number of years and it is indeed surprising that during peace-time, the chemical industry did not adopt them more widely.

Synthetic resins are also used in the manufacture of air-drying paints, varnishes and enamels which have greater durability and resistance to chemical attack. The 100 percent phenolics especially developed for the paint industry from more complex phenols have been readily adopted and greatly appreciated as paints and enamels based on them resist not only alkalis and acids, but withstand severe weather conditions.

The problem of finding a suitable lining for a large storage tank-container, which had occupied the attention of chemical engineers for the past many years, having at last been satisfactorily solved, many industries have readily adopted these synthetic resinoid materials. An increasing number of users is to be found where sterile conditions are needed or where resistance to acid or other corrosive solutions is required. In particular, the following trades may be mentioned: Breweries, bakeries, canneries, dairies, fruit juice and syrup manufacturers, industrial and fine chemical factories, textile industries, pickling and plating trades, and petroleum and solvent storage.

The best process for applying phenolic linings is the one originally developed in the United States. It can be applied to any metallic vessel after suitably pretreating it and hardening it by a portable furnace. When treated in this manner, the surface presents a hard, smooth, non-chipping, flexible, glass-like finish which is acid, corrosion and solvent-proof and which will not impart any trace of taste or odor to the most sensitive products and will not provide any breeding ground for bacteria. If necessary the repairs can be carried out *in situ* and without dismantling.

The electroplating industries employ resinoid materials in large quantities. To prevent the growth on the cathode, the metal hooks are insulated from the electrolyte by coating with resinoid. Electroplating barrels and tanks of resinoid materials are now a common practice in the industry as wood is not only very scarce but also it has been found that the resinoid equipment has comparatively much longer life.

Electrolytes corrode the metallic gears badly. Raw hide swells through the same cause. Resinoid materials,

however, are not affected at all. Gears cut from the resinoids have now been running for a number of years in the electroplating industries, without showing any trace of wear.

PAPER INDUSTRY

Winding of finished paper has hitherto been carried out on cardboard or strawboard tubes. The weight of the paper which could be wound on these rolls was necessarily limited, as otherwise the tube would collapse. Laminated resinoid tubes are now extensively used as they are easier to handle and allow larger weights of paper to be wound on one roll.

Steel doctor blades in the papermaking machines have been replaced with synthetic resin ones. The lower coefficient of friction between the resinoid doctor blades and the steel drums has resulted in a lower rate of wear. The metal rolls are not scored and consequently corrosion is avoided.

Suction covers for papermaking machines which were formerly made from wood are now constructed from synthetic resin materials. Swelling of wood resulted in quick wear of the wire screens which used to break easily when caught on splinters. Covers made from resinoid do not swell with resulting decreased rate of wear.

Benzol recovery plants, manufactured totally from resinoid materials, have been installed and are giving entire satisfaction. In the coal gas byproduct recovery, benzol distillation columns constructed from synthetic resins are rapidly replacing the metallic columns.

Absorption towers which were usually made from metals are now almost exclusively manufactured from resinoids. Hydrochloric acid perhaps has always been one of the most difficult acids to handle on an industrial scale. The acid attacks metal rapidly, corroding it with resultant discoloration of the acid. Resinoid absorption towers are unaffected by the acid and are therefore superior to the metal one in the production of hydrochloric acid. Towers up to 40 ft. high and 7 ft. in diameter are now in use in this country. They are made in sections of 10 ft. and assembled by means of steel flanges or spigots and socket connections.

In the manufacture of bleaching powder by the tower process, scraper arms are required to move the lime layers alternately outwards and inwards on succeeding platforms while dilute chlorine moves in countercurrent. These scrapers were constructed of metal and periodically coated with a crude pitch composition to prevent the corroding action of chlorine on the metal. The life of such scrapers was invariably short. Chlorine-resisting resinoids are now used for the construction of these scrapers and have given full satisfaction.

Large use is also being made of resinoid equipment in breaking up of ore, rare earths and residues, and in metallurgy, especially electrolysis of copper, zinc, tin and cobalt.

The author wishes to express his thanks to Messrs. Kestner Evaporator & Engineering Co. Ltd., London, and Newton Chambers & Co. Ltd., Thorneliffe, England, for their kind cooperation in supplying photographs.

FILTRATION

(*Continued from page 84*)

could have been credited to the system, the overall efficiency would have been calculated as 67.8 percent.

The foregoing reveals that the thermal efficiency of a top-feed filter is good. However, it is clear that if the temperature of the air supplied to the hood can be increased, the efficiency will be still higher because of the greater amount of heat available per pound of air and because drying can be accomplished with less air. By using a higher air temperature, the temperature of the filtrate and of the leaving air, including entrained moisture, will be only slightly increased and more heat will be absorbed in evaporating water from the filtrate. Hence the exhauster must be designed to handle this greater amount of vapor, unless some means can be devised for complete condensation. This is not easily accomplished because velocities in all parts of the system are high and serious entrainment results so that a large part of the water used to condense the vapors may be drawn through the exhauster, possibly damaging it.

On the other hand, use of low temperature air will decrease the overall thermal efficiency and raise the exhauster power needs. Entrainment, furthermore, can only be eliminated by using extreme care in design. When using low temperature air, an air volume of 1,000–1,275 cu.ft. per min. per ton of solids dried may be required, equivalent to about 175–200 cu.ft. per min. per sq.ft. of filter area.

Other variables encountered in top-feed filters include cake thickness, drum speed, liquid boiling point, cake moisture before drying, air temperature and final cake moisture. Cake thickness is generally predetermined by preliminary tests and is usually ½ to 1½ in. for normal operation or even as high as 2 to 2½ in. for short periods. Drum speed will generally be best chosen at between ¼ and 2 r.p.m. as determined from other factors such as tonnage, air temperature and permissible cake thickness.

The cake moisture depends largely on the particle size and on characteristics of the material, and must be determined by preliminary tests. Not including water of crystallization, it may vary between 1 and 12 percent of free moisture. The air temperature to be used may depend upon characteristics of the material and will generally range between 250 and 1,000 deg. F. However, it is desirable to keep temperature below 900 deg. F. to avoid special construction materials for handling the hot air.

Final cake moisture is usually specified between 0.05 and 2 percent. Since the heat in the product discharged from the filter is lost, some of this is used to finish the drying and the cake is ordinarily discharged at about ½ percent higher moisture than required.

A word about materials of construction is in order here. Operating conditions in a top-feed filter are particularly severe, owing to elevated temperature and to abrasion caused by high velocities of air and water, especially where entrained solid particles are encountered. Thus the choice of proper construction materials is a matter requiring the engineer's best efforts.

In conclusion, it seems that a filter installation for granular materials must be individually engineered to the requirements of each specific problem. Paramount among the designer's equipment must be experience in handling of filtration problems. Further than this, he must understand the chemical and physical characteristics of the material handled. Thus, fullest cooperation between designer and user is essential. Finally, for the benefit of future installations, the designer should be given access to results obtained from installations already in operation.

CHEM & MET REPORT ON

Southern Chemical Progress

TO CHEMICAL ENGINEERS AND EXECUTIVES

The Southern States have been the principal beneficiaries of the decentralization movement that has swept the country in recent years. But just as it is shifting into high gear the United States has become faced with an emergency that already is having tremendous effect upon even the most remote corners of the land. What will be its effect upon the movement? Has it been arrested? If so will it be temporary or permanent? And with the development of the "Arsenal of Democracy," how much of it will be located in the Southern States?

While trends in the South are of primary interest to Southerners they are certain to have a tremendous influence upon many managements and engineers in the North, East and West. With this broad interest in mind the editors have gathered together data that it is hoped may help to answer these questions that are uppermost in so many minds at this time.

CHEMICAL AND METALLURGICAL ENGINEERING

JULY, 1941

$553,000,000 Building Program Underway

SUMMARY AND CONCLUSIONS

A tabulation of the electric power supply of each of the areas in the South is given. Both gas and coal fuels consumed in the various sections of the United States show the relative industrial importance of each. Bureau of Census figures for 1939 give for the 13 Southern states the number of plants of each industry, number of wage earners, value of product and other data. A list of the process industries plants under construction or that have been announced, gives name of operator or owner, location, products, and investment.

Industrialization of the South is in high gear. The tremendous sum of $553,024,000 is being invested in new production facilities in the process industries. And many more large developments are on the horizon. The volume of $853,254,000 for all types of construction in 1940 was a gain of 88 percent over the previous high of 1939. The South was a serious challenger of the Middle Atlantic for the greatest percentage of the nation's construction with 21.4 percent.

The past ten years have witnessed what undoubtedly has been the most important industrial development the South has ever experienced. It is true that after the first World War there was a tremendous migration of the textile industry southward but that activity was mostly confined to the Carolinas. This newer movement has been far more widespread, its influence has been felt from the Potomac and Ohio Rivers on the north to the Gulf Coast on the South, and from the Atlantic to the Rio Grande. Instead of being confined to a single industry the influx has applied to almost all types of industry, although more especially to the process industries.

This industrialization of the states below the Mason and Dixon Line was due to a natural major decentralization movement that got under way. It was brought on by increasing high taxes, higher labor costs, higher transportation charges and other adverse factors in the North.

The South has had much to offer industry. Within its boundaries are one-third of the total area of the United States and one-third of the population, lower taxes, adequate transportation facilities, few labor troubles, a mild climate and matchless natural resources. The only wonder is that the section remained primarily agrarian so many years.

Management finally recognized these advantages and the movement has gained momentum rapidly. Will this continue or will the present grave world disturbance that is upsetting plans and programs of all kinds everywhere have the effect of reversing the decentralization trend that has been accounting for the establishment of so many new industries in the South?

A review of the huge sums being invested in plant and equipment shows no indication of any reversal as yet. Although as Chester C. Davis, a member of The National Defense Advisory Commission, pointed out before the Southern Governors' Conference in New Orleans, at the time of the first World War this country expanded existing industries and located new war industries close to the centers of industrial activity. This result reinforced the industrial concentration of the Northern and Northeastern states. However, as he pointed out, this policy created some very serious problems. So great was the congestion of industrial activity in the northeastern triangle that in 1918 the War Industries Board was forced to suspend for a period all further war orders in a selected group of northeastern states. The task of supplying fuel and food to these areas had gone beyond the capacity of the railways and the ability of the main rail gateways to handle freight. Acute labor shortages developed in spite of mass migration into the Northeastern area. At the same time manufacturers outside of the area had a labor surplus and idle plant capacity. In many cases they were unable to use this labor and plant because of their inability to get materials which were tied up under priorities in the eastern areas. Perhaps the country learned its lesson for in the neighborhood of 20 percent of the defense contracts thus far awarded have been to the South.

While the progress in aviation has made it expedient for our government to adopt the policy of locating defense plant at least 200 miles from coast lines, it has been necessary in locating some plants to disregard this rule. Outstanding examples are the two magnesium plants that must be on tidewater as the sea water is the source of their raw material. Much of the area of the 13 Southern States is within 200 miles of the sea, however the entire areas of Tennessee and Oklahoma, Arkansas and vast portions of others of the states are in the "safety zone."

Present activity in the process industries in the South may serve to throw some light on the future course of the industrial development in that section of the United States.

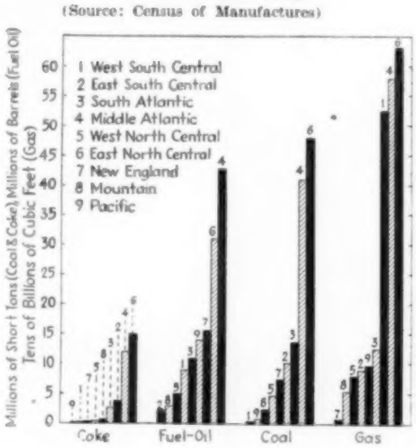
Alabama — Alabama with its unusual combination of iron ore and

coal in the neighborhood of Birmingham, has been one of the leading industrial regions in the South. However, interest in this area is now over shadowed by other industrial development in the state.

The federal government has spent enormous sums through the Tennessee Valley Authority in the development of hydroelectric power at Muscle Shoals. And it now appears quite likely that this organization will shortly receive enormous new funds for the construction of additional dams. While developing the great supply of energy T.V.A. has built and operated a phosphate fertilizer plant. A few months ago an appropriation was made for an ammonium nitrate plant at the Shoals and it is expected to be in operation in the fall.

T.V.A. has also encouraged large private consumers to locate in its territory. Electro Metallurgical Co. invested one or two million dollars in a ferro-alloy plant at the Shoals several years ago and is now increasing the capacity of the plant several fold. At Lister is a plant of the Reynolds Metals Co. This plant produces alumina and feeds aluminum reduction plants of the company at the same point and at Longview, Wash. The Southeast seems certain to be the location of most of the aluminum industry for not only is cheap power important but transportation is likewise a determining factor.

Consumption of fuel by manufacturing establishments: 1939
(Source: Census of Manufactures)



In another part of the state the Aluminum Ore Co. has the largest alumina plant in the world. Last year the capacity was increased 50 percent and at the present time it is again being increased. The company is also constructing a $2,000,000 plant to supply steam and electricity for its operations. This sum will raise the Aluminum company's investment at Mobile to $10,000,000.

This fast growing port is also a center of the pulp and paper industry. The Chickasaw mill of Hollingsworth and Whitney Co. is one of the finest and newest of its kind in the country.

Childersburg is the Alabama site of ordnance works which will be operated by the E. I. du Pont de Nemours & Co. The $48,000,000 smokeless powder plant is now under construction and a few weeks ago announcement was made of an additional appropriation of $24,675,000 to cover production facilities for TNT, DNT and tetryl. Nearby is the site of the Brecon Loading Co.'s plant constructed at a cost to the government of $14,394,000.

Arkansas—Arkansas has depended primarily upon farming, forests and mines. Its bauxite and other minerals have been shipped elsewhere to be processed and returned to the state for resale. Commenting recently on the state's aims for industrial development in the *Manufacturers Record,* Gov. Homer M. Atkins said, "If Arkansas is to move forward at a speed commensurate with the increased production of her natural resources, it is going to be necessary to process more and more of these raw materials here at home for local consumption and for exporting. The time has come when our people are awakening to the possibility of development along these lines; we can see the dawn of a new day for Arkansas. But there is broad groundwork to be accomplished before any sizeable industrial objectives can be achieved."

Changes in demand for power in the southern supply areas indicated on the map are traced in the table shown below

However, Arkansas does have some industrial plants and is now about to be the site of several of the national defense projects. The Maumelle Ordnance Works will be located at Marche. For this picric acid plant the government has made an appropriation of $16,750,000. At Jacksonville the Ordnance Department has a $35,000,000 detonator plant.

Florida—Florida is not all devoted to the entertainment of pleasure seekers. The northern part has several large new pulp and paper mills, which have been attracted by the vast forests of pine trees. Five of the seventeen pulp and paper mills that have been constructed in the South in recent years have been located within this state. A sixth pulp mill, the Panama City mill of Southern Kraft Corp., has been here for eleven or twelve years. Not far away at Pensacola, is the mill of the Florida Pulp and Paper Co. At Port St. Joe is the mill of the Port St. Joe Paper Co.

Across the state at Jacksonville is

Electric Power Requirements and Supply by Power Supply Areas

Source: National Defense Power Survey, Federal Power Commission

Power supply area	6	18	20	21	22 & 23	24	25	33	35	37	38
Requirements during March, 1941											
Net generation, 1,000,000 Kwh	372	131	562	435	426	128	115	81	67	177	99
Energy for load, 1,000,000 Kwh	328	118	534	476	470	123	113	87	67	170	114
Peak load, 1,000 Kw	633	244	900	966	931	299	241	189	116	352	247
Forecast of future requirements											
June, 1941											
Energy, 1,000,000 Kwh	321	117	524	441	444	99	132	94	72	186	136
Peak, 1,000 Kw	640	252	946	961	880	221	270	198	125	388	285
Max. for next 12 months											
Month and year	12/41	12/41	12/41	12/41	12/41	2/42	9/41	9/41	7/41	9/41	9/41
Energy, 1,000,000 Kwh	366	128	628	509	470	123	159	99	72	200	139
Peak, 1,000 Kw	783	317	1,128	1,070	990	321	320	216	125	418	299
Required reserves Mar., 1941, 1,000 Kw	80	66	26	93	38	65	35	62	34	69	73
End of 1941, 1,000 Kw	745	327	974	1,155	1,115	347	326	274	158	466	314
End of 1942, 1,000 Kw	858	345	1,382	1,255	1,162	347	336	274	158	479	364

the mill of the National Container Corp. and a few miles away at the fishing village of Fernandina are the mills of the Container Corp. of America and of the Rayonier Corp. This last mill is of particular interest as it has the unique distinction of being the only one in the entire country that is producing pulp from southern pines by the sulphite process. The pulp is being used to make rayon.

Florida has a large naval stores plant belonging to the Newport Industries at Pensacola, and a cane sugar mill near the Everglades. But one of the most important industries in the State is based on the enormous deposits of phosphate rock. In 1939 more than 2,791,000 tons of the rock were mined and in some years even greater tonnages have been produced.

Georgia—The state of Georgia has been best known in recent years for the part it has played in the great expansion of the southern pulp and paper industry. It was at Savannah that Dr. Charles L. Herty had his laboratory and made his headquarters. The first of these new mills, the Union Bag and Paper Co. was located there. The state is also the location of one of the latest mills to be built. The St. Marys Kraft Corp. commenced construction near Kingsland in October. This $2,500,000 mill will make kraft pulp. The amount put into this mill brings the total invested in pulp and paper mills in the South during the present wave of construction well over $100,000,000.

The pine forests that cover so much of the State serve not only as a raw material for the pulp and paper industry, but they supply the naval stores, Georgia's No. 1 industry, with its raw material. In fact, Savannah is the headquarters for the industry. There are enormous numbers of small rosin and turpentine producers throughout the State and the huge plant of Hercules Powder Co. is at Brunswick.

At Rome, Tubize Chatillon Corp. is expanding its viscose and acetate rayon manufacturing facilities. At Macon, Reynolds Corp. is building a fuse loading plant as part of the national defense program. Certain-Teed Products Corp. is spending $150,000 for increasing its insulating papers plant at Savannah. National Oil Products Co. at Cedartown is expanding and so is Nelio Resin Processing Corp. at Savannah.

Louisiana—Just now attention is focused on the oil fields and refineries for it has been proposed to lay several pipe lines for transporting oil and gasoline from this region to Eastern and Southeastern cities. The Plantation Pipe Line Co's. proposal would carry gasoline from Baton Rouge to Greensboro, N. C. The Memphis Natural Gas Co. would pipe gas from Monroe. A more ambitious proposal is to connect the producing fields of Louisiana and Texas with the New York and Philadelphia areas by pipe lines. Suggestions are for a 24-in. crude and a 20-in. gasoline line to cost about $70,000,000 each.

One of the newest refineries is under construction at Cotton Valley where the Cotton Valley Operators Committee is investing $2,000,000 in a recycling plant. At Baton Rouge is the large refinery of the Standard Oil Co. of La. In April the $3,000,000 synthetic rubber plant at the refinery produced its first Buna rubber. An expenditure of $15,000,000 will be involved in expansion. There will be an annual capacity of 15,000 tons of synthetic rubber, of which 5,000 will be butyl, and 20,000,000 gal. of alcohol. Baton Rouge is the center of a chemical industry of which the refinery is the nucleus.

Over at Bogalusa the Gaylord Container Corp. is putting $6,000,000 into further expansion of its already very large pulp and paper mill.

In the northern part of the state there are several kraft pulp mills. The Springhill mill is the largest kraft pulp mill in the world and is the pride of Southern Kraft Corp. Also in North Louisiana are oil and natural gas fields, and the carbon black industry.

According to advice from Louisiana, "Mathieson very probably will

DATA ON CHEMICAL AND ALLIED INDUSTRIES OF THIRTEEN SOUTHERN STATES

Source: Census of Manufactures, 1939

State and Industry	Establishments	Wage Earners[1]	Cost of Materials, Containers, Fuel, & Power,[3] — $1,000	Value of Products,[2] — $1,000
ALABAMA				
All industries, total: 1939	2,052	116,800	$327,287	$574,670
1937	1,874	120,301	336,328	573,764
Cement	8	1,033	3,136	7,989
Clay refractories[11]	4	235	268	651
Coal tar products	3	155	2,028	3,017
Cottonseed oil, cake, meal, linters	28	1,226	9,139	10,757
Fertilizers	42	1,129	6,758	9,453
Gum naval stores[4]	68	87	886	1,239
Insecticides, fungicides[5]	6	24	131	261
Lime	9	475	609	1,156
Oven coke and coke-oven byproducts	6	1,451	15,226	20,139
Paper bags[7]	3	1,101	6,110	7,905
Perfumes, cosmetics	3	14	32	97
Vegetable and animal oils	4	119	1,062	1,153
Chemicals and allied products	23	1,293	7,672	17,721
Stone, clay, and glass products	11	821	1,205	3,192
Paper and allied products	8	1,813	....	....
Rubber products	3	1,248	....	....
ARKANSAS				
All industries, total: 1939	1,178	36,254	$92,777	$160,167
1937	1,048	37,280	99,089	164,676
Cottonseed oil, cake, meal, and linters	26	1,436	14,138	17,341
Fertilizers	8	119	779	1,285
Paperboard containers, n. e. c.	3	102	283	508
Petroleum refining	6	612	11,034	14,328
Chemicals and allied products	15	229	828	1,679
Products of petroleum and coal	3	61	381	726
FLORIDA				
All industries, total: 1939	2,083	52,728	$123,523	$241,539
1937	1,835	52,005	113,138	217,045
Chemicals not elsewhere classified	5	106	317	772
Compressed and liquefied gases[3]	5	38	106	414
Fertilizers	58	1,356	10,511	15,035
Insecticides, fungicides[5]	15	109	594	1,066
Lime	9	209	109	442
Paints, varnishes, and lacquers	14	30	287	503
Paper and paperboard mills	3	940	7,335	14,125
Paperboard containers, n. e. c.	5	96	470	700
Pulp mills	5	1,144	5,152	9,146
Wood naval stores	7	510	1,570	3,338
Chemicals and allied products	14	122	696	1,132
GEORGIA				
All industries, total: 1939	3,150	157,800	$394,087	$677,403
1937	2,875	159,496	439,145	708,652
Compressed and liquefied gases[3]	7	46	190	600
Cottonseed oil, cake, meal, linters	51	1,782	13,830	16,488
Drugs and medicines	16	77	403	2,768
Fertilizers	133	2,281	14,009	19,050
Gum naval stores[4]	438	547	7,939	10,207
Insecticides, fungicides[5]	11	71	393	581
Paints, varnishes, and lacquers	10	89	867	1,588
Paperboard containers, n. e. c.	15	521	2,790	4,133
Perfumes, cosmetics, toilet prep.	13	98	368	766
Tanning materials[9]	6	212	1,552	2,696
Vegetable and animal oils	7	172	1,467	1,724
Paper and allied products	15	2,671	13,258	24,458
Chemicals and allied products	17	2,011	5,468	13,204
Products of petroleum and coal	7	307	2,135	3,157
Leather and leather products	12	856	....	....

For footnotes see page 99.

add a $7,000,000 magnesium unit to its already capacious plant. If constructed, the unit will utilize dolomite as the source of its magnesium carbonate."

New Orleans needs no introduction to the chemical process industries. For many years it has had its alcohol, cotton seed oil, fertilizer and numerous other plants. To the west of the City is the "sugar bowl" where many of Louisiana's 72 raw sugar mills are located. Much of the sugar is brought to the city to be refined. And the molasses from the refineries account for the alcohol plants. The bagasse is the principal raw material of the wallboard plant of the Celotex Co.

Celotex, Chase Bag Co., Flintkote Co., and Metallurgical Products Co. are spending large sums on new production facilities. And of tremendous importance to the defense program is the recently announced anhydrous ammonia plant costing $16,750,000 for Sterlington, near Monroe. It is understood that ammonia will be made from natural gas.

Maryland—Due to the proximity to vast markets for industrial products the cities of Maryland have long had their industries. Cumberland has its glass and rayon plants. It is the home of a plant of the Celanese Corp. of America, which is undergoing expansion at the present time. And Hagerstown has its leather companies, an airplane plant and other enterprises.

Near Baltimore is the huge plant of Calvert Distillery, the U. S. Navy's powder factory, the roofing plant of Ruberoid Co., the acid works of Standard Wholesale Phosphate and Acid Works, Procter and Gamble's soap plant and the Triumph Explosives' plant. All of these plants are in process of being further enlarged.

A few miles to the north of the city is the Edgewood Arsenal, where the Chemical Warfare Service is spending several millions of dollars of plant expansion. This has been the center of the activities of this branch of the service since the days of the first World War.

Mississippi — Mississippians are proudly telling of their oil resources and of the refinery of the Mid South Refining Co. being erected at Jackson to process the State's newly discovered oil. The plant calls for an outlay of $1,000,000.

They also will tell you about the $3,000,000 roofing materials plant of the Flintkote Co. at Meridian which was barely completed before an increase was decided on. At Yazoo City several hundred thousand dollars are being invested in the refinery of the Paluxy Asphalt Co. And at Laurel the Masonite Corp. is further expanding its plant.

Mississippi is one of the leaders in the movement to make America free from outside sources of tung oil. The nuts have been brought to a plant at Picayune to be pressed. But now comes announcement of a new plant at Hintonville to be erected at a cost of $75,000.

Like Georgia, this state is one of the leading sources of naval stores. Besides the numerous little gum plants scattered throughout the pine belt, there is the large gum and wood plant at Hattiesburg of the Hercules Powder Co.

North Carolina—Perhaps the best balanced and one of the most progressive states below the Mason and Dixon Line is North Carolina. Among its chief inducements to industry is its supply of hydroelectric power. The state now ranks fourth in the nation in hydroelectric capacity. Its total production last year was in excess of 2,500,000 kilowatt hours. And this capacity appears likely to be increased shortly by the development at Fontana. OPM has recently recommended a 40,000,000 lb. (annual capacity) aluminum plant to be located in the state.

The Aluminum company has a metal plant at Badin and it is undergoing expansion at this time.

In the Great Smokies region is the unique plant of the Ecusta Paper Corp. upon which the cigarette man-

DATA ON CHEMICAL AND ALLIED INDUSTRIES OF THIRTEEN SOUTHERN STATES

Source: Census of Manufactures, 1939

State and Industry	Establishments	Wage Earners[1]	Cost of Materials, Containers, Fuel, & Power,[2] — $1,000	Value of Products,[2] — $1,000
LOUISIANA				
All industries, total: 1939	1,861	71,218	$365,179	$565,265
1937	1,684	76,057	380,984	590,840
Bone black, carbon black, lampblack	6	211	859	2,094
Cane sugar refining	7	3,247	58,110	66,674
Chemicals not elsewhere classified	11	1,269	11,628	32,507
Compressed and liquefied gases[3]	13	93	262	1,024
Cottonseed oil, cake, meal, linters	21	732	6,388	7,824
Drugs and medicines	9	62	236	563
Fertilizers	12	524	3,288	4,652
Insecticides and fungicides[5]	7	18	60	152
Liquors, rectified or blended	5	21	172	296
Paints, varnishes, lacquers	13	166	1,369	2,084
Paper and paperboard mills	8	2,536	18,253	25,650
Paper bags[7]	5	926	3,703	5,744
Paperboard containers, n. e. c	9	622	2,675	4,538
Perfumes, cosmetics	5	31	194	403
Petroleum refining	13	2,629	95,483	109,627
Printing ink	4	13	166	441
Pulp mills	7	1,787	8,549	13,817
Roofing, built-up and roll[8]	3	308	2,118	4,156
Wood naval stores	3	307	623	1,419
Paper and allied products	4	59	210	360
Chemicals and allied products	10	497	1,167	3,115
Products of petroleum and coal	1	19	....	....
Leather and leather products	2			
MARYLAND				
All industries, total: 1939	2,893	141,643	$604,505	$1,027,354
1937	2,683	145,932	665,027	1,095,863
Chemicals not elsewhere classified	10	1,016	6,199	12,546
Cleaning and polishing preparations	17	124	766	1,648
Compressed and liquefied gases[3]	6	67	261	853
Fertilizers	38	1,991	11,937	18,094
Glass containers	4	1,260	1,764	5,919
Grease and tallow[10]	4	54	570	757
Insecticides, fungicides	12	104	1,069	2,043
Leather goods, n. o. c.	4	31	26	84
Lime	8	226	280	711
Liquors, distilled	13	449	2,723	4,568
Paints, varnishes, lacquers	22	278	2,204	3,838
Paper and paperboard mills	9	1,800	6,261	10,081
Paper bags[7]	3	87	310	620
Paperboard containers, n. e. c.	25	1,171	3,520	6,115
Printing ink	3	8	80	145
Rubber products, n. e. c.	12	689	1,350	2,659
Paper and allied products	4	311	1,290	2,386
Chemicals and allied products	22	8,382	18,974	53,944
Products of petroleum and coal	7	1,375	30,417	37,512
Leather and leather products	11	612	2,169	3,257
Rubber products	5	1,122	....	....
MISSISSIPPI				
All industries, total: 1939	1,294	46,355	$101,475	$174,937
1937	1,100	46,040	114,446	190,671
Cottonseed oil, cake, meal, and linters	41	2,131	20,264	24,794
Fertilizers	13	369	2,209	3,291
Gum naval stores[4]	24	27	334	469
Wood naval stores	7	934	2,439	5,035
Chemicals and allied products	8	29	164	309
Paper and allied products	5	....	....	....
Rubber products	1	....	....	....
Leather and leather products	1	....	....	....

For footnotes see page 99.

ufacturers of the United States must depend for most of their paper. This mill was constructed only a year or two ago but the world situation has cut off the supply from France and so this mill is now being expanded at a cost of $2,000,000.

Among the other industries of the state that are increasing their capacities are the Southern Cotton Oil Co. at Fayettesville and the Sylva Paperboard Co. at Sylva. With the opening in a few weeks of the Dayton Rubber Mfg. Co.'s new plant at Waynesville, the state will add a new industry to its long and expanding list.

Oklahoma—Oklahoma remains the great oil producer and Tulsa the center of much of the activity of the industry in this country. Great numbers of men are employed in the fields, refineries, and offices of the numerous companies in the state and most of the population derives its living from petroleum. Several of the establishments are undergoing expansion and new gasoline recycling plants are under construction.

South Carolina—Charleston has an important and diversified industry and with the completion of the Santee-Cooper hydroelectric project it should further improve its position.

The hydroelectric development is scheduled to be finished early in the fall. Work on this $50,000,000 project is being rushed and unless the erratic Santee River misbehaves, there is every reason to believe the project will be completed on time. It should be prepared to produce its annual output of 700,000,000 kw.hr.

This state has profited by the influx of pulp and paper mills. Attracted by a plentiful supply of pine and water the West Virginia Pulp and Paper Co. chose North Charleston for the site of its new kraft mill a few years ago. Since its completion several appropriations have been made to recover chemicals and for other purposes. Just to the north at Georgetown is one of the largest of the mills of the Southern Kraft Corp. It was built four years ago at a cost of $8,000,000, and is now being expanded at a cost of between $2,000,000 and $3,000,000.

South Carolina is a leading producer of fertilizer with plants at Charleston, Columbia, Spartanburg, Greenville, Anderson and several other cities.

Tennessee — Tennessee has long been a producer of large volumes of chemicals and is taking a lead in the present industrial expansion. Chattanooga, Memphis, Nashville, Kingsport, Copperhill, Columbia, Mt. Pleasant, and many other centers are well known in the process industries.

At Alcoa the Aluminum Co. of America is spending $15,000,000 in order to increase capacity. The U. S. Ordnance Department has announced an appropriation of $39,000,000 for a TNT, DNT and tetryl plant at Chattanooga. Southern Chemical Cotton Co. is expanding its plant in the same city. So is the Tennessee Products Corp., which is spending nearly $2,000,000. Over at Ducktown the new Tennessee Copper Co.'s sulphuric acid plant will cost $1,000,000. Tennessee-Eastman appears to be carrying on an expansion program continually at Kingsport. The Wolf Creek Ordnance Plant at Milan under construction at a cost of $14,000,000 will be operated by Procter & Gamble.

At Memphis is the smokeless powder plant, known as the Tennessee Powder Co. operated by E. I. du Pont de Nemours & Co. To the powder plant has recently been added TNT and DNT plants. R. H. Bogle Co. is constructing a plant at Memphis for the production of sodium chlorate. At Columbia, Monsanto Chemical Co. has installed a fourth electric furnace in its phosphorus plant.

Texas—The new industrial crop in the Lone Star State is taking on tremendous proportions. While the number of new products in the petroleum industry is very large, there are many developments in other industries that are attracting

DATA ON CHEMICAL AND ALLIED INDUSTRIES OF THIRTEEN SOUTHERN STATES

Source: Census of Manufactures, 1939

State and Industry	Establishments	Wage Earners[1]	Cost of Materials, Containers, Fuel, & Power,[2] — $1,000	Value of Products,[2] — $1,000
NORTH CAROLINA				
All industries, total: 1939	3,225	270,210	$875,377	$1,421,330
1937	2,896	258,711	908,903	1,384,738
Cottonseed oil, cake, meal, and linters	37	742	5,188	6,077
Drugs and medicines	14	249	1,141	3,829
Fertilizers	70	1,923	12,542	17,855
Insecticides, fungicides	6	24	112	322
Leather: tanned, curried, and finished	8	937	6,810	9,206
Paints, varnishes, lacquers	4	49	880	1,590
Paper and paperboard mills	7	1,100	4,734	9,627
Paperboard containers, n. e. c.	21	853	2,394	4,500
Pulp mills	4	1,077	3,474	7,100
Tanning materials[9]	9	302	1,147	2,364
Paper and allied products	4	....	....	....
Chemicals and allied products	15	....	....	....
Leather and leather products	4	....	....	....
OKLAHOMA				
All industries, total: 1939	1,606	28,113	$209,050	$312,168
1937	1,428	29,551	255,470	366,089
Compressed and liquified gases[3]	7	44	149	491
Cottonseed oil, cake meal, linters	29	651	4,838	6,142
Glass containers	5	650	1,746	3,341
Insecticides, fungicides[5]	9	25	178	491
Lubricating oils and greases[6]	6	40	578	1,000
Paperboard containers, n. e. c.	4	140	759	1,281
Petroleum refining	27	4,278	88,582	106,667
Chemicals and allied products	21	226	1,150	2,387
Rubber products	3	....	....	....
Leather and leather products	2	....	....	....
SOUTH CAROLINA				
All industries, total: 1939	1,331	126,980	$227,666	$397,513
1937	1,193	129,748	234,433	409,912
Cottonseed oil, cake, meal, and linters	30	816	6,350	7,586
Fertilizers	76	1,565	8,693	11,702
Gum naval stores[4]	32	27	248	379
Paints, varnishes, and lacquers	5	32	292	433
Tanning materials[9]	5	10	166	242
Paper and allied products	13	2,433	11,152	19,924
Chemicals and allied products	12	112	603	976
Products of petroleum and coal	3	....	....	....
Rubber products	2	....	....	....
TENNESSEE				
All industries, total: 1939	2,289	131,874	$407,746	$728,088
1937	2,083	135,073	412,360	707,987
Chemicals not elsewhere classified	9	2,129	9,576	25,639
Compressed and liquefied gases[3]	10	64	171	761
Cottonseed oil, cake, meal, linters	15	1,020	13,087	15,391
Drugs and medicines	22	649	3,107	8,057
Fertilizers	12	593	3,279	5,402
Insecticides, fungicides[5]	17	168	865	1,990
Lime	15	584	353	1,087
Paints, varnishes, lacquers	9	203	2,234	3,279
Paperboard containers, n. e. c.	14	742	2,137	3,825
Perfumes, cosmetics	8	158	750	1,707
Pulp mills	6	747	4,108	7,257
Rubber products, n. e. c.	4	31	82	156
Tanning materials[9]	6	253	1,060	1,802
Paper and allied products	13	1,002	4,206	7,527
Chemicals and allied products	16	227	1,703	2,163
Products of petroleum and coal	6	160	1,503	2,308
Leather and leather products	7	442	2,145	2,976

nation-wide attention. The Dow Chemical Co. recently completed a plant at Freeport for the recovery of magnesium and bromine from sea-water and an auxiliary caustic soda-chlorine plant. The federal government has recently made an appropriation of approximately $12,000,000 for the expansion of facilities for the production of magnesium. Carbide and Carbon Chemicals Corp. is constructing a synthetic organic chemicals plant at Texas City.

Near Houston, Humble Oil & Refining Co. is at work on a toluol plant to cost $11,857,000. It is being financed by the government. Shell Oil Co. early in May announced the award of a contract for the erection of an additional toluol plant at its refinery. The combined capacity of Shell's plants will be 4,000,000 gal. of toluol per year. The plants are at Deer Park.

The $3,500,000 government-owned tin smelter designed to smelt low-grade Bolivian ore is under construction at Texas City. Diamond Alkali Co. of Texas was incorporated in February to manufacture alkalis and other chemicals in Texas. A tract of land at Dallas was purchased and construction of a new plant to manufacture silicate of soda and silicate products was started. Pittsburgh Plate Glass Co. is building its seventh paint plant at Houston. One of the South's first large soap plants is being erected by Procter & Gamble at Dallas, where the company already has a cottonseed oil plant. Shell Oil Co. at Houston has a butadiene plant and Phillips Petroleum Co. has a similar plant at Borger.

DATA ON CHEMICAL AND ALLIED INDUSTRIES OF THIRTEEN SOUTHERN STATES

Source: Census of Manufactures, 1939

State and Industry	Establishments	Wage Earners [1]	Cost of Materials, Containers, Fuel, & Power,[2] — $1,000	Value of Products,[2] — $1,000
TEXAS				
All industries, total: 1939	5,376	126,996	$1,077,115	$1,530,221
1937	4,422	129,501	1,141,568	1,581,422
Batteries, storage and primary	15	365	2,043	3,635
Bone black, carbon black, and lampblack	37	1,200	4,654	11,123
Cement	10	1,260	3,935	12,726
Chemicals not elsewhere classified	12	703	2,440	6,479
Cleaning and polishing preparations	5	20	65	152
Compressed and liquefied gases [3]	27	192	490	2,033
Drugs and medicine	21	146	580	1,582
Fertilizers	17	192	1,387	2,018
Flavoring extracts, etc., n. e. c	16	112	2,716	8,466
Gypsum products	5	326	856	3,226
Insecticides, fungicides [5]	19	38	447	902
Lime	7	181	221	531
Mineral wool	4	30	36	81
Paints, varnishes, lacquers	25	193	2,380	4,457
Paperboard containers, n. e. c	17	404	1,524	2,753
Perfumes, cosmetics	12	94	795	1,180
Petroleum refining	113	18,931	576,381	698,850
Rubber products, n. e. c.	7	93	446	816
Soap and glycerin	4	20	104	141
Paper and allied products	16	1,133	4,133	7,952
Chemicals and allied products	20	263	1,324	3,134
Leather and leather products	4	....	....	....
VIRGINIA				
All industries, total: 1939	2,579	133,896	$609,325	$988,813
1937	2,384	132,643	572,374	908,222
Chemicals not elsewhere classified	14	2,430	13,887	33,554
Compressed and liquefied gases [3]	9	101	293	1,148
Drugs and medicines	9	62	361	1,516
Fertilizers	43	1,869	13,797	19,377
Grease and tallow [10]	5	142	586	930
Insecticides, fungicides [5]	6	15	99	184
Leather: tanned, curried and finished	7	442	2,964	4,247
Lime	26	916	1,021	2,163
Liquors, distilled	4	35	158	260
Paints, varnishes, and lacquers	9	72	833	1,420
Paper and paperboard mills	11	2,542	16,645	26,751
Paper bags [7]	7	518	1,965	2,767
Paperboard containers, n. e. c	17	726	2,548	4,286
Printing ink	3	14	102	226
Pulp mills	9	1,888	9,936	17,073
Rayon and allied products	5	10,786	18,921	59,672
Tanning materials [9]	6	261	929	1,843
Paper and allied products	6	357	993	1,802
Chemicals and allied products	12	184	1,193	2,360
Leather and leather products	17	4,402	7,828	13,708
Stone, clay, and glass products	8	978	1,539	5,252

[1] The Census of Manufactures questionnaire, for the first time, called for personnel employed in distribution, construction, etc., separately from the manufacturing employees of the plants, and therefore the data are not comparable. Figures given are averages of the numbers reported for the several months of the year.

[2] Profits or losses cannot be calculated from census figures because no data are collected for certain expense items such as interest, rent, taxes, etc. Totals for cost of materials and value of products include large but indeterminable amounts of duplication due to the use of the products of some industries as materials by others. This duplication occurs, as a rule, between different industries and is not found to any great extent in individual industries.

[3] Not made in oil refineries or natural gasoline plants.

[4] Processing, but not gathering or warehousing.

[5] Includes related industrial and household chemical compounds.

[6] Not made in petroleum refineries.

[7] Except paper bags made in paper mills.

[8] Includes asphalt shingles, roof coating (except paint).

[9] Includes natural dyestuffs, mordants, assistants and sizes.

[10] Except lubricating greases.

[11] Including refractory cement (clay).

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Virginia—Rayon plants of Virginia are expanding to provide for the increasing demand for their products. Celanese Corp. of America is reported to be planning early construction of a new mill in the vicinity of Verona, Augusta County. Proposed mill is reported to cost in excess of $1,000,000, du Pont has approved plans for a large addition to its rayon mill at Amphill to cost $500,000 with equipment. Construction is scheduled to begin soon. Already this company has an investment in the South that is said to be in excess of $200,000,000. Celanese Corp. is expanding its new rayon mill at Pearisburg. It is reported to have appropriated $1,500,000 for the project.

America's largest viscose rayon mill at Front Royal belonging to American Viscose Corp. is now getting under way. It is expected that the plant will reach its full capacity of 50,000,000 lb. in 1942.

Du Pont has recently increased its nylon capacity by the addition of a plant at Martinsville, Va.

In order to supplement manufacturing facilities of its vitamin plants at Rahway, N. J., Merck & Co. is constructing a plant near Elkton in the Shenandoah Valley.

In March the huge new powder plant at Radford was dedicated. The Radford Ordnance Works is being operated by Hercules Powder Co. for the government. At nearby Pulaski the same company is also operating a bag-loading plant. The probable cost of these two plants is in the neighborhood of $45,000,000.

This brief summary and the list of process industry projects, totalling $500,529,000, on the following page give a general picture of the enormous amount of activity among the chemical industries in the South. Obviously, only the construction programs involving a very large investment in plant and equipment could be mentioned.

This industrialization of the Southern states also applies to industry in general. The volume of $853,254,000 in 1940 was a gain of 88 percent over the previous high of 1939. The South was a serious challenger of the Middle Atlantic for the greatest percentage of the nation's construction with 21.4 percent.

NEW PLANT CONSTRUCTION OR EXPANSION IN THE SOUTHERN PROCESS INDUSTRIES

ALABAMA

Owner and/or Operator	Location	Product	Estimated Cost
Aluminum Co. of Amer.	Mobile	Alumina expansion	$3,000,000
Brecon Loading Co.	Childersburg	Bag loading	9,437,000
Chemical Warfare Service	Huntsville	Chemicals	40,000,000
E. I. duPont de Nemours & Co. (Alabama Ordnance Works)	Childersburg	Smokeless power, TNT, DNT, Tetryl	72,675,000
Electro Metallurgical Co.	Muscle Shoals	Ferro alloys	3,000,000
Lion Oil Refining Co.	Elrado	Gasoline	400,000
Reynolds Metals Co.	Lister	Alumina, aluminum	25,601,211
TVA	Muscle Shoals	Phosphate expansion	1,000,000
TVA	Muscle Shoals	Ammonium nitrate	6,500,000

ARKANSAS

Owner and/or Operator	Location	Product	Estimated Cost
Maumelle Ordnance Works	Marche	Picric acid	8,000,000
Williams Roofing Co.	Camden	Roofing papers	40,000
U. S. Ordnance Dept.	Jacksonville	Detonators	33,500,000

FLORIDA

Owner and/or Operator	Location	Product	Estimated Cost
Newport Industries	Pensacola	Terpene chemicals	150,000
Florida Pulp & Paper Co.	Pensacola	Pulp and paper	3,000,000
St. Joe Paper Co.	Port St. Joe	Kraft pulp	40,000

GEORGIA

Owner and/or Operator	Location	Product	Estimated Cost
Certain-teed Products Corp.	Savannah	Insulating papers	150,000
National Oil Products Co.	Cedartown	Sulphonated oils	40,000
Nelio Resin Processing Corp.	Savannah	Resins	150,000
Reynolds Corp.	Macon	Fuse loading	2,000,000
St. Marys Kraft Corp.	St. Marys	Kraft pulp	2,500,000
Tubize Chatillon Corp.	Rome	Rayon expansion	2,450,000

LOUISIANA

Owner and/or Operator	Location	Product	Estimated Cost
Celotex Corp.	Marrero	Insulating board expansion	175,000
Chase Bag Co.	New Orleans	Paper containers	240,000
Cotton Valley Operators Comm.	Cotton Valley	Recycling plant	2,000,000
Flintkote Co.	New Orleans	Roofing expansion	88,920
Gaylord Container Corp.	Bogalusa	Pulp, paper	6,000,000
Mathieson Alkali Works	Lake Charles	Magnesium	6,500,000
Memphis Natural Gas Co.	Memphis to Monroe	Gas pipe line	800,000
Metallurgical Products	Shreveport	Iron carbonyl	125,000
Plantation Pipe Line Co.	Baton Rouge to Greensboro, N. C.	Gasoline pipe line	15,000,000
Not yet announced	Minden	Ammunition loading	19,000,000
Standard Oil Co. of La.	Baton Rouge	Alcohol, synthetic rubber	15,000,000
Standard Oil Co. of La.	Baton Rouge	Butadiene	10,000,000
Not yet announced	Monroe	Ammonia	16,750,000
Thompson-Hayward Chemical Co.	New Orleans	Chemicals	62,500

MARYLAND

Owner and/or Operator	Location	Product	Estimated Cost
Calvert Distillery	Relay	Distillery expansion	40,000
Celanese Corp. of America	Amcelle	Rayon expansion	....
Chemical Warfare Service	Edgewood		5,900,000
Naval Powder Factory	Indian Head	Powder expansion	3,490,000
Lever Bros. Co.	Baltimore	Soap	250,000
Procter & Gamble Co.	Baltimore	Soap	65,000
Standard Wholesale Phosphate & Acid Works	Baltimore	Phosphate expansion	....
Triumph Explosives, Inc.	Elkton	Ammunition components	202,950

MISSISSIPPI

Owner and/or Operator	Location	Product	Estimated Cost
Flintkote Co.	Meridan	Roofing materials	3,000,000
Mid South Refining Co.	Jackson	Oil refinery	1,000,000
Masonite Corp.	Laurel	Insulating board expansion	1,500,000
Paluxy Asphalt Co.	Yazoo City	Refinery	250,000
G. L. Reasor	Hintonville	Tung oil	75,000

NORTH CAROLINA

Owner and/or Operator	Location	Product	Estimated Cost
Aluminum Co. of Amer.	Badin	Aluminum expansion	....
Dayton Rubber Mfg. Co.	Waynesville	Rubber products	90,000
Ecusta Paper Corp.	Pisgah Forest	Cigarette paper expansion	2,000,000
North Carolina Pulp Co.	Plymouth	Pulp	2,000,000
Southern Cotton Oil Co.	Fayetteville	Cotton oil refinery	40,000
Sylva Paperboard Co.	Sylva	Pulp Mill	250,000

OKLAHOMA

Owner and/or Operator	Location	Product	Estimated Cost
Magnolia Petroleum Co.	Oakwood	Gasoline recycling plant	350,000
Magnolia Refining Co.	Tulsa	Recycling plant	1,000,000
Omar Refining Co.	Garber	Refinery expansion	....

SOUTH CAROLINA

Owner and/or Operator	Location	Product	Estimated Cost
General Asbestos & Rubber Co.	Charleston	Asbestos products	....
Southern Kraft Corp.	Georgetown	Pulp expansion	2,000,000
West Virginia Pulp & Paper Co.	Charleston	Pulp expansion	350,000

TENNESSEE

Owner and/or Operator	Location	Product	Estimated Cost
Aluminum Co. of Amer.	Alcoa	Aluminum expansion	15,000,000
R. H. Bogle Co.	Memphis	Alkali chlorates	200,000
Delta Refining Co.	Memphis	Gasoline	500,000
Ernst Bischoff Co.	Memphis	Chemicals	120,000
Humko Co.	Memphis	Vegetable oils	200,000
Procter & Gamble (Wolf Creek Ordnance Plant)	Milan	Ammunition loading	11,159,350
Southern Chemical Cotton Co.	Chattanooga	Cotton linters expansion	151,000
Tennessee Copper Co.	Ducktown	Sulphuric acid	1,000,000
Tennessee Products Corp.	Chattanooga	Coke	1,816,800
U. S. Ordnance Dept.	Chattanooga	TNT, DNT, tetryl	39,000,000
U. S. Ordnance Dept.	Copperhill	Sulphuric acid	2,375,000

TEXAS

Owner and/or Operator	Location	Product	Estimated Cost
Amer. Smelting & Refining Co.	Corpus Christi	Electrolytic zinc	5,200,000
Benedum & Trees	Freer	Gasoline	125,000
Carbide & Carbon Chem. Corp.	Texas City	Chemicals	5,000,000
Champlin & Bass	Freer	Recycling plant	1,100,000
Champlin & Bass	San Diego	Recycling plant	150,000
Chicago Corp.	Corpus Christi	Recycling plant	450,000
Coastal Refining Co.	Port Isabel	Refinery expansion	100,000
Continental Oil Co.	Harlingen	Bulk plant	56,000
Continental Oil Co.	Rio Grande	Recycling plant	300,000
Continental Oil Co.	Robberson		200,000
Continental Oil Co.	Rio Grande City	Topping plant	100,000
Diamond Alkali Co. of Tex.	Dallas	Silicate of soda	285,000
W. S. Dickey Clay Mfg. Co.	Texarkana	Clay products	45,000
Dow Chemical Co.	Freeport	Magnesium, chlorine, caustic expansion	12,000,000
Firestone Tire & Rubber Co.	Houston	Warehouse	40,000
Geier Bros. & F. B. Jackson	Grapeland	Recycling plant	450,000
Gulf Oil & Refining Co.	Big Sandy	Oil pipe line	70,000
Gulf Portland Cement Co.	Houston	Cement	250,000
Gulf States Oil Co.	Edinburg	Recycling plant	225,000
Harrison & Abercrombie	Old Ocean	Recycling plant	100,000
Harrison & Abercrombie	Shepherd	Recycling plant	250,000
Humble Oil & Refining Co.	Baytown	Toluol	11,857,000
Humble Oil & Refining Co.	Katy	Gasoline	2,700,000
Hunt Oil Co.	Palestine	Butane	100,000
O. W. Kellam	Alice	Recycling plant	250,000
O. S. Knisely	East Bernard	Recycling plant	350,000
Knox Glass Bottle Co.	Palestine	Bottles	200,000
Lone Star Gas Co.	Longview	Recycling plant	300,000
Magnolia Petroleum Co.	Fort Worth	Refinery	300,000
McCullum Oil Co.	Zapata	Repressuring plant	100,000
Owens-Illinois Glass Co.	Waco	Glass containers	1,000,000
Petroleum Rectifying Co.	Houston	Oil refinery	42,000
Phillips Petroleum Co.	Beeville	Recycling plant	250,000
Phillips Petroleum Co.	Borger	Oil refinery expansion	100,000
Phillips Petroleum Co.	Borger	Butadiene	....
Pittsburgh Plate Glass Co.	Houston	Paints	450,000
Procter & Gamble	Dallas	Soap	1,000,000
Republic Production Co.	Silsbee	Stabilization plant	90,000
Shell Oil Co.	Deer Park	Butadiene	3,000,000
Shell Oil Co.	Deer Park	Refinery expansion	56,000
Shell Oil Co.	Deer Park	Toluol	500,000
Shell Oil Co.	Harrisburg	Toluol	250,000
Stanolind Oil & Gas Co.	Lafayette	Gasoline	500,000
Texas Co.	Ballaire	Oil refinery expansion	55,000
Texas Natural Gas Co.	Borger	Gasoline	100,000
Tin Processing Corp.	Texas City	Tin smelter	3,500,000
United Carbon Co.	Aransas Pass	Carbon expansion	275,000
U. S. Ordnance Dept.	Texarkana	Shell loading	45,500,000
H. B. Zachry & Co.	Ganado	Recycling plant	1,250,000

VIRGINIA

Owner and/or Operator	Location	Product	Estimated Cost
Celanese Corp. of America	Pearisburg	Rayon expansion	1,500,000
Celanese Corp. of America	Verona	Rayon	1,000,000
E. I. duPont de Nemours & Co.	Amphill, Richmond	Viscose rayon	500,000
E. I. duPont de Nemours & Co.	Martinsville	Nylon	11,000,000
Hercules Powder Co.	Pulaski	Bag loading	9,376,390
Hercules Powder Co.	Radford	Smokeless powder	36,390,000
Merck & Co.	Elkton	Chemicals	1,500,000
Morgan Brothers	Richmond	Paper bags	50,000
Smith-Douglass Co.	Norfolk	Sulphuric acid	250,000

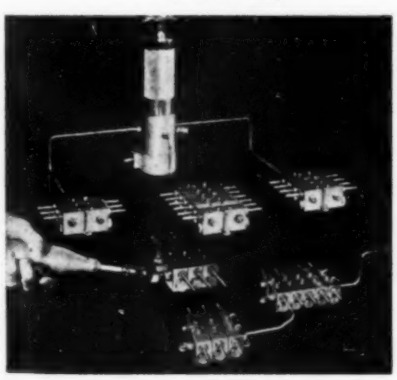
Machinery, Materials and Products

Hydro Classifier

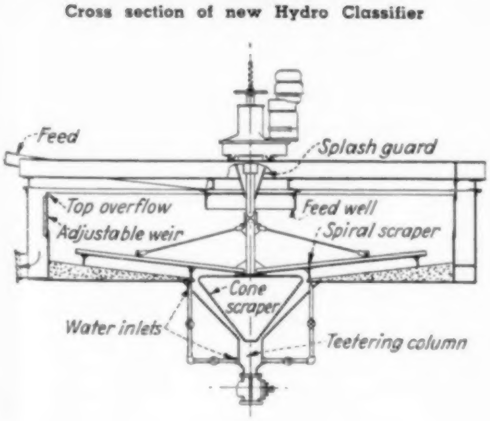
First offered several years ago, the Hydro Classifier manufactured by the Hardinge Co., York, Pa., has recently been improved in several design features. These features are said to permit making various sizes of products on one machine by varying the available retention volume and also to permit better cleaning of the sands before they are discharged.

The equipment consists of a circular steel tank divided into two compartments, a main or upper one, equipped with an adjustable overflow weir in which agitating and collecting spiral rakes operate, and a conical lower compartment where a final wash is given to the product. Various sizes of product may be made on the one machine by varying the volume available for retention and hence the settling-out period. This is accomplished through a telescopic type peripheral weir which permits varying the classifier depth from a maximum to half the maximum, or to any intermediate point. By this arrangement the underflow may be sized from practically all plus 80 mesh, to practically all plus 240 mesh, according to the manufacturer. Material finer than the selected size is removed over the weir.

Single-pipe lubricator showing various methods of feeding



Cross section of new Hydro Classifier



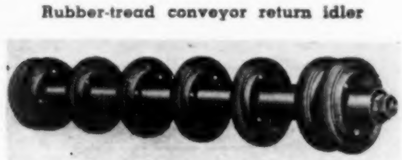
A second interesting feature shown in the accompanying cross-sectional view is the cleaning chamber for the sand product which is below the raking section. Here water enters tangentially, giving a swirling action for the removal of the last traces of fines. Other features include this company's Auto-Raise mechanism for preventing overloading of the scraper. It is stated that a 1½ hp. motor is sufficient to operate a 20-ft. diameter classifier.

One-Pipe Lubricator

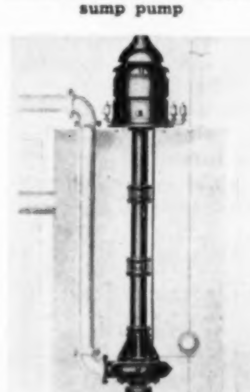
Forced-feed centralized lubrication employing a single-pipe system has been announced by Trabon Engineering Corp., 1814 East 40th St., Cleveland, Ohio. The new system is said to be less costly because of reduction in piping and simplification of valves and installation. The lubricant distribution system consists of a bank of three or more sections, each of which discharges a known and measured quantity of lubricant alternately through one or two discharge outlets which are direct connected to the bearings.

The capacity of the different sections of the same distributor may vary from 0.005 cu. in. to 0.035 cu. in. Consequently, by selecting the proper number and capacity of sections, and supplying the proper amount of lubricant to the inlet, a single distributor discharging progressively through one outlet or another, will deliver just the desired amount of lubricant to all connected bearings, even though requirements of the individual bearings may differ widely. Either oil or grease may be distributed. As shown in the accompanying view, a distributor may be supplied with lubricant either manually by means of a hand-gun, or it may be fed from a discharge outlet of another distributor, or from a metering feeder.

Rubber-tread conveyor return idler



Industrial type submerged sump pump



Return Idler

Development of a new line of rubber-tread idlers for supporting the return run of 14- to 60-in. wide belt conveyors has been announced by Link-Belt Co., 220 South Belmont Ave., Indianapolis, Ind. Each complete idler consists of from four to twelve 6-in. diameter rubber-tired rolls, suitably spaced and mounted on a steel tube equipped with roller bearings. The idler is designed to fit into the same supporting hangers as this company's regular return idler rolls. Individual rolls consist of a renewable extruded rubber tire, clamped between two steel disks firmly held together by bolts. Tires are split for easy replacement. The new design is especially recommended by the maker for conveyors handling corrosive, abrasive, wet and sticky materials, since there is only rubber-to-rubber contact between idlers and the under side of the conveying belt. Furthermore, the kneading action of the rubber tread is said to prevent build-up of material on the belt and to help in loosening ice forming on the belt in freezing weather.

Submerged Sump Pump

Designed specifically for intermittent duty in sump or bilge pumping and submerged service, a new line of non-clogging centrifugal pumps designated as type 5410 SS has been introduced by Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago, Ill. The new pumps are built in 2 to 5-in. sizes for capacities up to 1,400 g.p.m., and heads to 120 ft. In the larger sizes, they are claimed capable of handling solids up to 3 in. in diameter without difficulty.

As shown in the accompanying illustration, this pump is designed for suspension from the floor level. The pump proper is this company's well-known trash type, with inclosed im-

peller. The motor is of the vertical, hollow-shaft, waterproof type, employing the company's copperspun rotor. Wearing rings and stuffing box are eliminated and lubrication is provided to the pump bearings either by sight-feed or by multiple-feed solenoid oilers.

Heat Exchanger

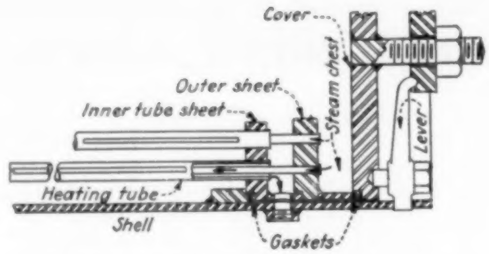
SEVERAL new developments in heat exchanger and evaporator design have been announced by Heat Transfer Products, Inc., 90 West Street, New York, N. Y. These are built around what is known as the Leverlox principle of attachment of heads to cylindrical equipment. Without the use of flanges or flange bolts, this design locks the head, or cover, into the shell through the use of a series of levers the outer ends of which pass through holes in the periphery of the shell, while the inner ends are supported by a plate attached to the center of the head. Cap screws passing through the levers can be tightened up to seal the cover against the gasket. In equipment in which the heat transfer surface is to be removable from the end, the tube sheet may be held in place in the same fashion as the cover, as shown in the accompanying cross section.

One new design introduced by the company is an atmospheric evaporator for water which incorporates special self-scaling tubes to eliminate need for frequent removal of the tube bundle for cleaning. The tubes are thermostatic in nature, consisting of a copper tube to one side of which a steel bar is attached to form a thermostatic bimetal. Each tube is closed at one end and rolled into an inner tube sheet, serving as a heater and drainage tube for condensate. Inside the first tube is a second non-thermostatic tube, rolled into an outer tube sheet, forming the steam supply. Temperature changes when the evaporator is shut down or started up cause bending of the normally straight outer tubes, thus cracking off scale.

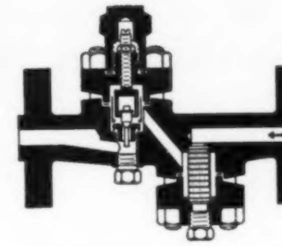
New Smaller Transformer

EMPLOYING a newly developed and improved magnetic material known as Hipersil, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has announced a new line of smaller, lighter transformers for distribution use which are as much as 25 percent less in size and weight than comparable distribution transformers made with the best conventional silicon steels. The new transformers are available in sizes from 1½ to 500 kva., for voltages of 2,400, 4,800 and 7,200.

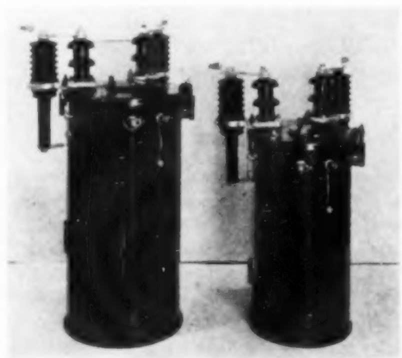
The new magnetic steel is stated to have a flux-carrying capacity about one-third greater than ordinary silicon steel, yet in carrying this increased flux, it requires no more magnetizing force and its losses are said to be no greater. Its sound-producing prop-



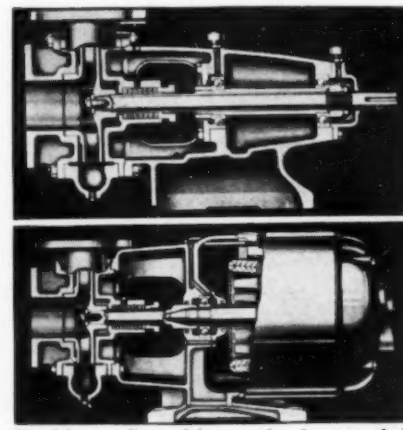
Evaporator detail showing lever-locked head and self-scaling tube



High pressure steam trap



Conventional distribution transformer compared with smaller Hipersil transformer



Flexible-coupling drive and close-coupled centrifugal pumps

erty is reduced so that increased magnetic flux causes no increase in sound level. Among other improvements, Hipersil permits a considerable reduction in copper requirements, reducing copper losses and permitting a greater short-time overload capacity. Still another advantage of the new transformer is that since the new magnetic cores are assembled in two pieces, they may be taken apart easily for replacement of coils, if this should become necessary.

New Centrifugal Pumps

LONG a specialist in turbine-type pumps, Micro-Westco, Inc., Bettendorf, Iowa, has now announced a new line of side-suction centrifugal pumps built in flexible-coupling drive models, in sizes from 1¼ to 6 in. inclusive, and in close-coupled models in sizes from 1¼ to 4 in. inclusive. These pumps are available in either inclosed or semi-open, non-clogging impeller designs. The flexible-coupling type is equipped with two oversized ball bearings, completely inclosed with flush-type lubrication. Extra deep stuffing boxes are used. Streamlined appearance is a feature, together with careful design of the volute to minimize turbulence and to reduce erosion. Discharge can be provided in four different positions without reducing accessibility of the stuffing box.

High Pressure Trap

FOR HIGH PRESSURE steam service up to 1,500 lb., at temperatures to 900 deg. F., Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa., has introduced its Superpressure type Impulse steam trap, based on the same operating principles as lower pressure members of this trap family, but designed especially for severe working conditions. As shown in the sectional view, the trap is of the flanged-end, bolted-bonnet design, but is also available with welding-socket ends. An integral strainer is provided. Opening and closing of the valve (the only moving part) is governed by changes of pressure in a control chamber above the valve piston. Capacity is stated to be ample for large amounts of condensate during warming-up periods. An important feature claimed for the trap is its positive closing in the presence of wet, saturated or superheated steam.

Forced Draft Burner

BUILT IN SIZES from 5 to 400 hp. is a new motorized-fan gas burner assembly introduced under the name of "Fan-Air" by Lee B. Mettler Co., 406 South Main St., Los Angeles, Calif. The burner, making use of this company's entrained combustion principle, features new automatic controls and a new safety pilot. It was designed to circumvent difficulties encountered with natural draft burners under unfavorable operating conditions such as overloaded boilers, limited furnace volume, short firing depths, low gas pressures and short stacks. The burner is claimed to give small plant owners the advantages and benefits of mechanical draft performance at moderate cost. Full electric on-and-off or throttling control is available. Combustion air is auto-

matically metered as the gas input is modulated, thus contributing to the reported high efficiency. Any gas may be burned at low pressure, while limited operation under natural draft is possible when desired.

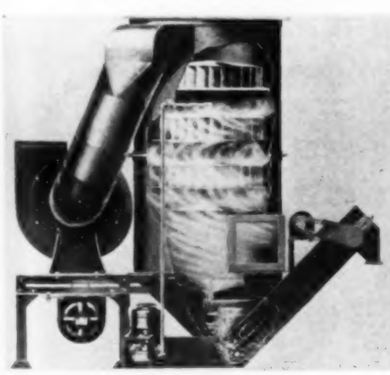
Unit Dust Collector

SEVERAL MODELS in a new line of unit dust collectors, built in capacities from 2,000 to 10,000 cu. ft. per min., have been developed by the Claude B. Schneible Co., 3951 Lawrence Ave., Chicago, Ill. These new models, designated as Type UC, consist of a fan, five-spray curtain tower, pump, settling chamber and sludge ejection conveyor. The collector tower is of this company's conventional Multi-Wash type, employing recirculated water in a cyclonic impingement section to remove dust and fumes from the air. Beneath the scrubber section is a settling chamber, sludge conveyor and water circulating pump. As shown in the accompanying view, the collector operates under induced draft. A feature of the design is that the sludge conveyor, operating at low speed, is said to dewater the sludge effectively, delivering it to any suitable container.

Iris Measuring Valve

AN ADAPTATION of its iris-diaphragm type valve has recently been developed by York Oil Burner Co., York, Pa., for use in the large-scale measuring, mixing and conditioning of gas. In a recent installation these valves were furnished in the 24-in. size to one of

New unit dust collector



Iris gas measuring valve

the country's largest steel plants for mixing blast furnace gas and coke oven gas to produce a mixture of constant B.t.u. content. An automatic calorimeter operates one of the iris metering valves by means of a hydraulic cylinder, instantly changing the valve setting as required. According to the manufacturer, this valve design is suitable for extreme fluctuations in gas requirements owing to its straight-line throttling characteristics and its ability to control flow rates as low as 5 percent of the total flow.

Solvent-Proof Gloves

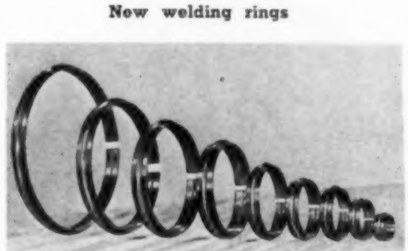
COMPLETE RESISTANCE against practically all organic solvents is claimed for the new transparent gloves produced from Resistoflex PVA by the Resistoflex Corp., Belleville, N. J. This material is a rubber-like substance which contains no sulphur and hence cannot tarnish metal surfaces. The material is stated to be of great mechanical strength and to be unaffected by oil, gasoline, benzol, carbon disulphide and chlorinated hydrocarbons. The new gloves are available in a variety of sizes, in lengths from 10½ to 18 in.

Welding Rings

A NEW SERIES of welding rings, designed for use with all sizes of straight pipe and with all types of this company's welding fittings, has been announced by Tube-Turns, Inc., Louisville, Ky. The new rings are claimed to assure a perfect full-strength joint and practically to eliminate the human element hazard in welding. Besides speeding up the actual welding process,

Resistoflex P V A solvent-proof glove

New welding rings



whether gas or electric arc welding, the new rings simplify lining up, requiring no clamps, guides or fixtures of any kind for supporting pipe and fittings for tack welding.

Metal Spray Gun

SEVERAL IMPROVEMENTS have been incorporated in its new Type 2E metal spray gun by the Metallizing Engineering Co., 21-07 41st Ave., Long Island City, N. Y. Two outstanding improvements include a new wire feed and a new gas head permitting complete interchangeability of gas fuels without changing heads. In previous guns, the wire feed was controlled by regulating the flow of air to the air turbine which provides power for feeding the wire. According to the manufacturer, considerable speed fluctuation under varying loads was possible, and gear changes were sometimes required. In the new unit, control of the wire speed is effected by means of a governor which is said to allow full power input at all times and eliminate speed fluctuations.

In previous guns, changing from one fuel gas to another required either a change of gas heads or the use of unbalanced gas pressures which made lighting difficult and back-fires likely. The new gas head is said to allow operation with any usual fuel gas under balanced pressure, without changing heads or dismantling the gun in any way. Improved spraying characteristics are also claimed, with any of the usual sprayed metals, together with simplified adjustment. The gun weighs only 4¾ lb. and is of simple, easily cleaned construction.

High-Nickel Alloy

AN ALLOY with a 73 percent nickel base, containing 14 percent of chromium, which is claimed to produce superior castings and to be immune to intergranular deterioration and carbide embrittlement, has been announced under the name of Neutralloy by the Bethlehem Foundry & Machine Co., Bethlehem, Pa. In the cast form, the alloy is said to be readily machinable, to weld easily and to be resistant to a wide variety of corrosive agents such as fruit acids, brine, photographic chemicals and those used in the manufacture of rayon. Excellent resistance to oxidation and elevated temperatures is claimed, together with high resistance to creep. An important point is that the corrosion resistance is developed, according to the manufacturer, in the "as cast" condition, without polishing or surface improvement.

Portable Generating Plant

RECENT ADDITIONS to its line of engine-powered generating plants, have been announced by the Bardco Mfg. & Sales Co., Dayton, Ohio and Los Angeles, Calif. Among these additions

are seven air-cooled units and ten water-cooled totally-inclosed models, all of which are self-contained and readily portable. Air-cooled units range from 500 to 2,000 watts at various voltages d.c., or 110-220 volts a.c. The water-cooled models are built in sizes of 3,000 and 5,000 watts a.c. or d.c. Fully automatic starting and stopping controls are optional equipment. The air-cooled models are generally hand-started and the water-cooled, electric-started, with built-in fuel tank, engine panel with all necessary instruments, and streamlined inclosure.

Valve Positioner

DESIGNED by Moore Products Co., 3629 North Lawrence St., Philadelphia, Pa., a new valve positioner for diaphragm-operated valves has been announced in which several improved features are evident. One novel device is a by-pass valve which immediately permits cutting out the positioner, without upsetting the control process. The unit is strongly built and provides adjustments for valve strokes of from ½ to 2½ in. The design is such that a linear relationship always exists between the instrument air pressure and the actual motion of the valve. Tests are stated to have shown a sensitivity of one-fifth of 1 percent of full-scale instrument pressure change. Air consumption is said to be small and speed of operation high.

Splashproof Motors

ADDING to the new line of Tri-Clad motors announced on page 138 of our February 1941 issue, General Electric Co., Schenectady, N. Y., has produced a series of splashproof ball-bearing, polyphase, induction motors in sizes from 1 to 15 hp. The new motors are especially designed for use in the presence of splashing water and other liquids, as in paper mills, chemical plants and laboratories. Like the earlier motors of the line, the new splashproof motors offer functionalized styling, with protection against physical damage, electrical breakdown and operating wear and tear. Ventilating openings in the stator frame and end shields are carefully baffled to prevent entrance of liquids, while a liquid-tight cast-iron conduit box built into the frame of the motor is provided for ease in making connections.

Respirator Goggle

COMPLETE eye protection is provided for workmen engaged in operations where respirators must be used, according to the manufacturer, by a new goggle recently introduced by Bausch & Lomb Optical Co., Rochester, N. Y. The goggle is of the metal-frame-spectacle type, cut away in the nasal portion to fit close to the face, yet leave sufficient room for the respirator. The goggle is offered with wire mesh, or with either clear or green acetate nose and side shields. Either plano or prescription hardened lenses can be supplied.

Equipment Briefs

A FULL-ELECTRIC wire-rope hoist of popular price, in capacities from 250 to 2,000 lb., has been announced by Harnischfeger Corp., Milwaukee, Wis. Known as the P & H Zip-Lift, the new hoist is light enough for a man to carry and is designed for mounting rigidly or on a hook or trolley, as desired. It operates with pushbuttons and is powered from an ordinary light circuit. Features of the design include double brakes, automatic limit switch and dust- and weather-proof construction.

TO FACILITATE cleaning and simplify access to the drum, American Meter Co., 60 East 42d St., New York, N. Y., is now building its wet test meters with a removable back head. The new head is also available for meters already in service. Any meters of this company's A1-18 series for general laboratory testing and calorimetry, including both low and high pressure models, may now be equipped with this device.

A NEW steel container known as the R-type Por-Pail is available in 5- and 10-gal. sizes from Wilson & Bennett Mfg. Co., 6534 South Menard Ave., Chicago, Ill. Suitable for packaging of paints, oils, chemicals and other solutions, the new pail is said to be improved in appearance while being designed to facilitate nesting one container on top of another. Three different pouring spouts are available. The pails are furnished either plain, or printed or lithographed as desired.

FOR USE with its V-Tite gaskets (used in ring-type joint flanges), the Goetze Gasket & Packing Co., New Brunswick, N. J., has developed an improved auxiliary seal known as the Protectoring. This is a formed ring, proportioned to fit, which is placed between the flange faces, inside the primary ring gasket, so as to protect the inner surfaces of the primary gasket and the exposed flange faces from chemical attack by the confined medium. The ring has the other effects of eliminating turbulence caused by the space between the mating flanges, and of preventing erosion of the flange faces and the primary gasket by scouring action of the liquid handled. A variety of corrosion resisting materials are available.

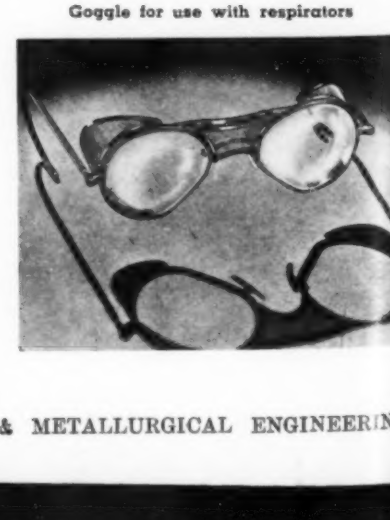
A NEW regrinding swing-check valve, designated as Fig. 92, for 125 lb. steam pressure at 500 deg. F., or 250 lb. non-shock cold fluid pressure, is announced by Jenkins Bros., 80 White St., New York, N. Y. Made in sizes from ½ to 2 in. the valve is claimed to introduce practically no restriction into the pipe. The disk may be reground without removing the valve from the line.

A NEWLY DESIGNED fluorescent lighting system recently announced by Benjamin Electric Mfg. Co., Des Plaines, Ill., is known as the Lite-Line system. Through the use of this construction, unbroken lines of light, row on row across an entire ceiling, can be provided to give high levels of illumination, up to 35-100 foot-candles on the working plane. The new system utilizes 48-in. fluorescent lights which may be joined together in series to form a continuous fixture of any desired length. If desired, twin-lamp units can be purchased with triple-lamp reflectors so that a third tube can be added later, if needed, by simply installing an additional ballast, compensator, socket, switch and lamp.

Positioner for control valves

Splashproof Tri-Clad motor

Goggle for use with respirators

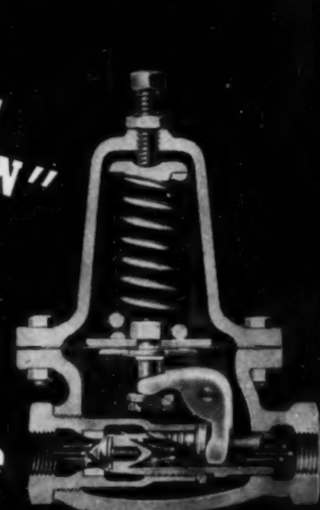


NO TROUBLE" "SPEEDS PRODUCTION"

"STOPS SPOILAGE"

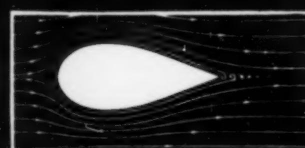
"Dependable"

"HIGH CAPACITY" "No Service Attention"

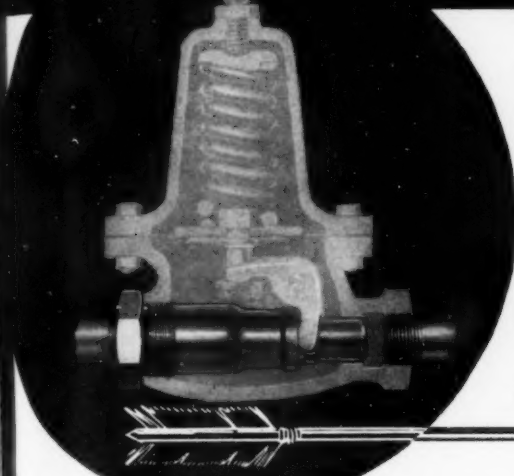


REDUCED PRESSURE *Never* VARIES

The streamlined flow offers unusual value to all users. It means no turbulence, just smooth, straight as an arrow flow. You are easily able to meet peak demand and yet hold the reduced pressure constant at the same time. Even though supply line pressure changes or demand changes, you still have smooth action—close, dependable regulation. You experience no spoilage results due to erratic pressure — because the reduced pressure never varies.



A CASH STANDARD "GET ACQUAINTED" COLUMN



Straight line flow all the way — straight as an arrow. Look at the phantom streamlined valve at the left — note the housing which contains the inner valve — you could easily mistake this housing for a pipe running straight through—straight as an arrow. We just emphasize in this way the reason why you get the straightline flow in the streamlined type 1000 CASH STANDARD Valves you buy — also it is the reason for such enthusiastic comments by users that you can read on this page.

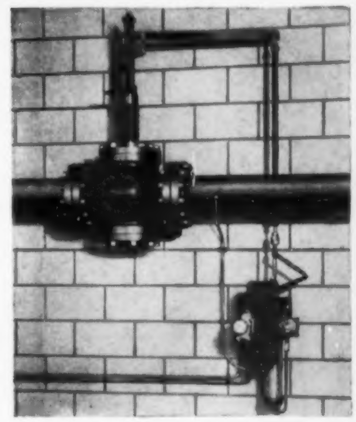
VALVE TURBULENCE ELIMINATED

The valve increases performance results by eliminating the ordinary valve turbulence indicated in illustration above. There is no detour around a dividing wall — the direction of flow is not changed at right angles because of a seat wall—also, the flow is not broken up by valve stems, springs, or other parts.

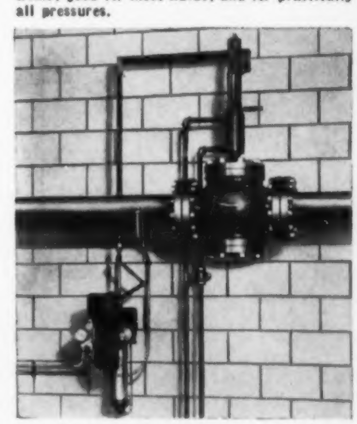
Straight as an Arrow

Question: "Don't you people make anything besides that Streamlined Valve you talk about so much?"

Answer: "Yes Sir; we do! And we propose to picture one or two of them here each time."



A revelation in precision control — the Cash Standard Balanced Lever Valve (Type 42-AC-R) being operated by a Type 100 Controller. Reducing steam at high pressure and high temperature, it has an Air Cooled Stuffing Box. Has valve stem lubricator, valve stem integral with inner valve, roller guides — no lost motion. Sizes: ½" to 12"; all trims; good for most fluids; and for practically all pressures.



And here is the same Valve and Controller, but with a Water Cooled Stuffing Box. This combination could be used for pressure reduction; but it is shown in use for precise back pressure control. Both cuts show a Hand Control Valve on the "100" Controllers. With it, you can interrupt automatic control, and take over control by hand, using the Hand Control Valve lever to manipulate the Balanced Lever Valve as you please, or lock it in any open or closed position you desire.

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

give you much more in production results at much less in cost . . .

Up above we say, "No Trouble" — "Speeds Production" — "Stops Spoilage" — "Dependable" — "High Capacity" — "No Service Attention" — then again at the left, experience has much to say—

— You can prove all this for yourself by using a CASH STANDARD Streamlined Valve FREE for 30 days. This NO COST trial opportunity is being taken advantage of from far and wide — tell us to ship you one on 30-days free trial. After 30 days you get a bill — you either pay for it then or return valve to us at our expense.

READ THE FACTS IN BULLETIN 1000

. . . IF YOU GO BY ERIENCE . . . .

'll Buy the Type 1000

what experience says

en say —
liners are accurate —
ever have to be touched —

say they specify your Streamlined lves because they are accurate, and they never had to touch one of them y were installed. I don't see how d wish for a better report."—Case

having Streamliner —
e two years old — Forgot because it gave no trouble —

sincere when I told you we had no ed Valve here because I look after Valves. But since you gave me the order number I looked into it and say is—You're right. There is But nobody has had to look at it was installed two years ago. I'm came back at me because I'm r Valves like that."—Case No. 360.

Valves —
e working well —
e no troubles reported —

got a lot of your Streamlined Valves they must be working well because had a single case of trouble re- them. When something works usually stick to it, so you'll be from us right along."—Case No.

dependable Valve —
liner stood lab tests —
s of plant experience confirm t —

the first '1000' Valve because n the hunt for a dependable Valve. y tests were so good we standard- it. Plant use confirmed lab tests. ctically no trouble with any of lves over a five year period — we n the hunt any more."—Case No.

Get Free Bulletins on Above . . . Write to A. W. CASH COMPANY

A. W. CASH COMPANY

CASH STANDARD CONTROLS — VALVES

Raw Sugar From Cane

In continental United States "sugar making" is limited to two of the most southern states, Louisiana and Florida. And yet it is one of the most important industries in those Gulf Coast areas; in Louisiana alone there are 72 mills devoted entirely to the making of raw sugar. The most modern of these mills is the New Iberia plant of the Iberia Sugar Cooperative.

Sugar cane is delivered to the mill in truck, railroad car and barge, and either transferred directly to steel tables or to storage in the yard by derricks. The tables feed cane onto the carriers where a set of knives chop the cane into chips. These chips are then passed through the crusher which disintegrates the cane and expresses about 75 percent of the juice. The crusher is followed by a series of four three-roller mills which continue the extraction of the juice until about 94 percent of the sucrose in the cane has been removed.

Raw juice is strained, weighed and pumped to liming tanks where milk of lime is added to raise the pH to a point which has been predetermined as being the best for flocculating and settling. The temperature is raised to 220 deg. F. and the juice pumped into clarifiers. Clear juice goes to the evaporator supply tanks and muds are pumped to the filter station. Spent muds are pumped to cane fields where they serve as fertilizer. Juice is concentrated in evaporators and vacuum pans to 90-95 deg. Brix and "U" type crystallizers prepare the semi-liquid for the centrifugals. The brown sugar from the centrifugals is shipped to refineries and the molasses goes to alcohol plants. For more details of the process refer to pages 77-79, Making Cane Sugar for Refining, by G. L. Pace.

CHEMICAL & METALLURGICAL ENGINEERING

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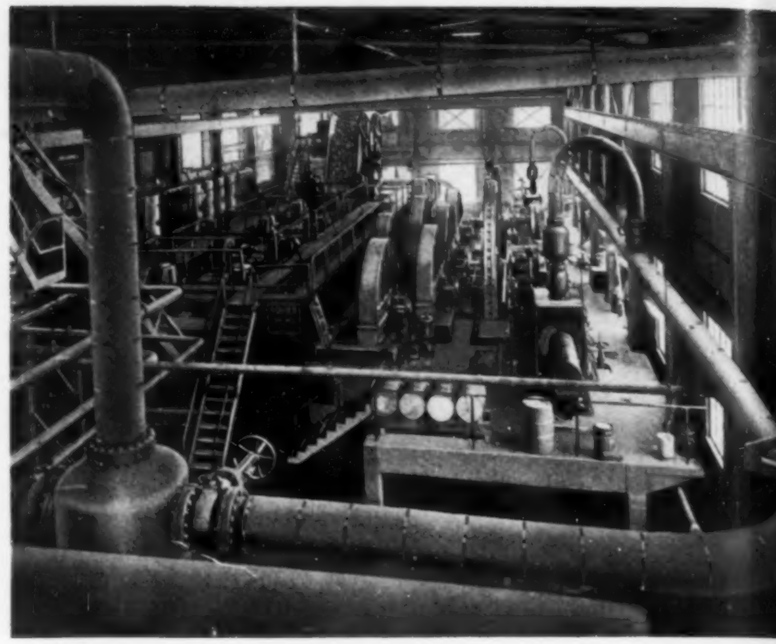
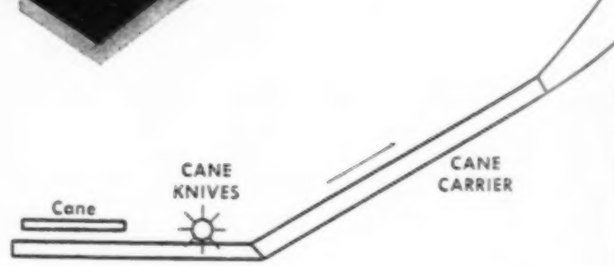
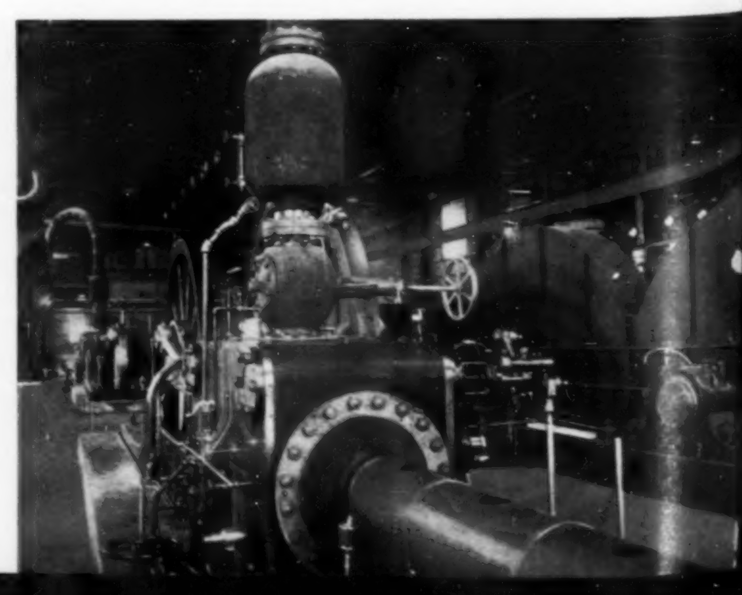


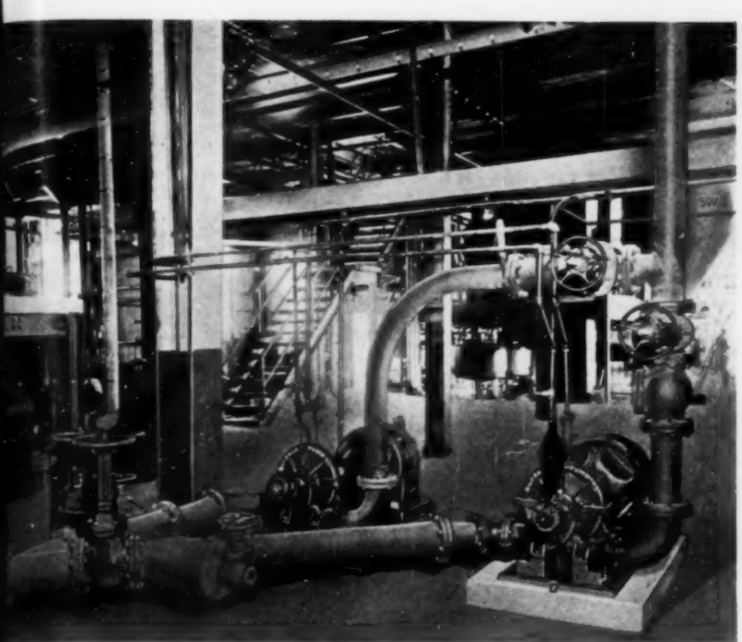
1 The heart of a raw sugar factory is the milling unit. Cane is brought by a carrier, chopped, crushed to remove 94 percent of sucrose

A *Chem & Met* FLOW SHEET



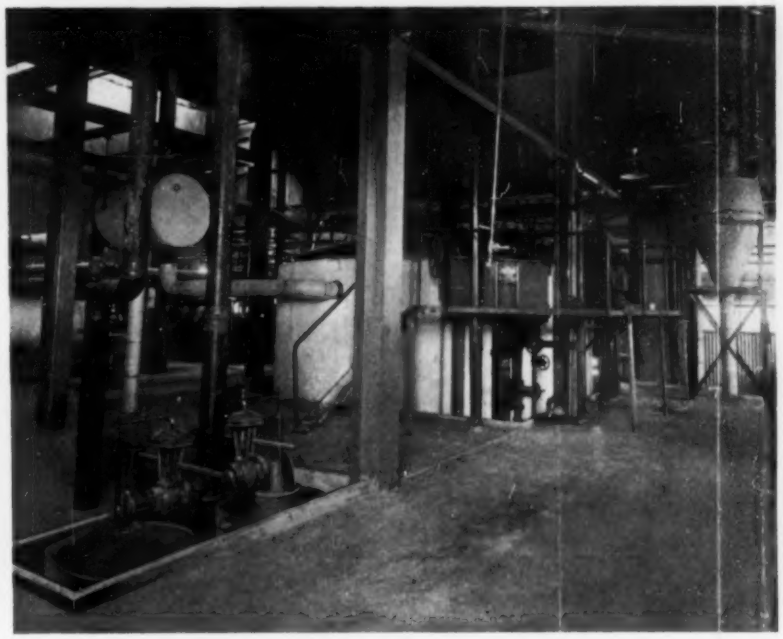
2 Mill is driven through a set of double reduction spur gearing by h duty engines. One drives crusher and first mill and other the last three





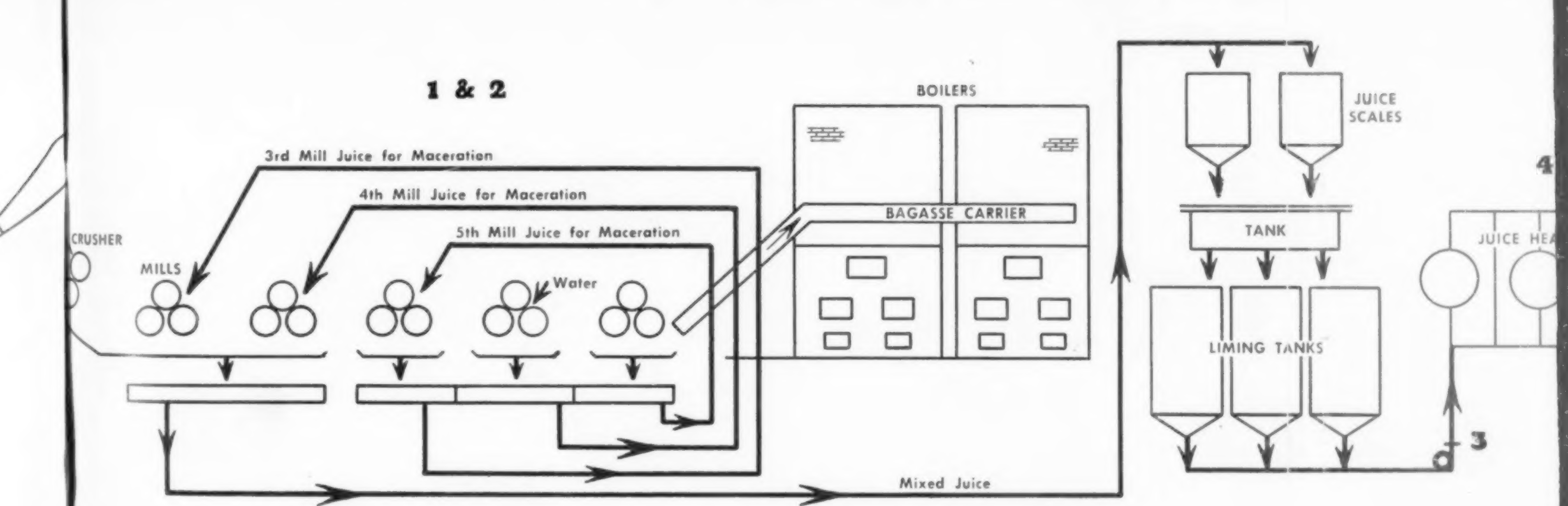
brought

Stainless steel pumps convey juice to scales. The juice is then limed in
with agitators to the pH at which the best flocculation occurs



5 Hot raw juice limed to proper pH is settled in a continuous clarifier. Clear juice passes to evaporator supply tank. Muds are pumped to filter station

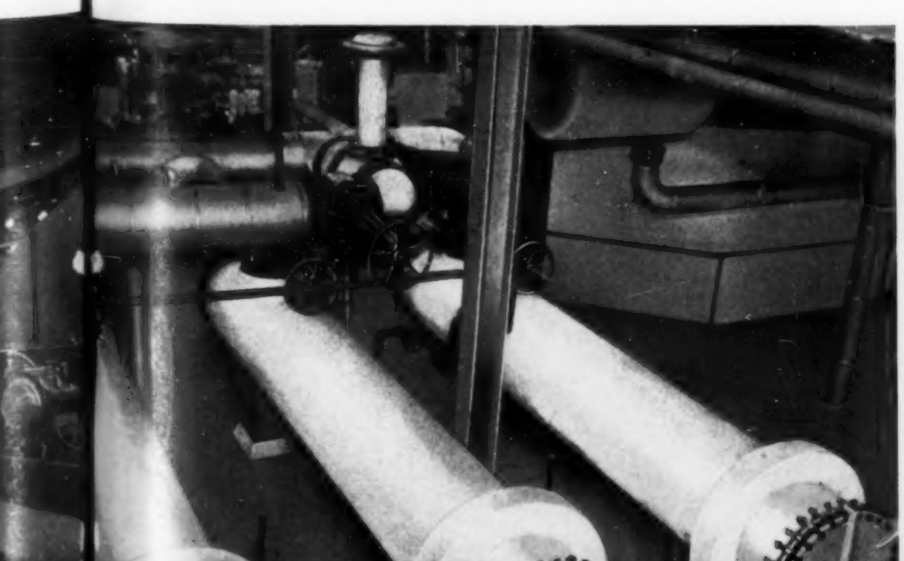
7 Quadruple ef
condenser. Juice

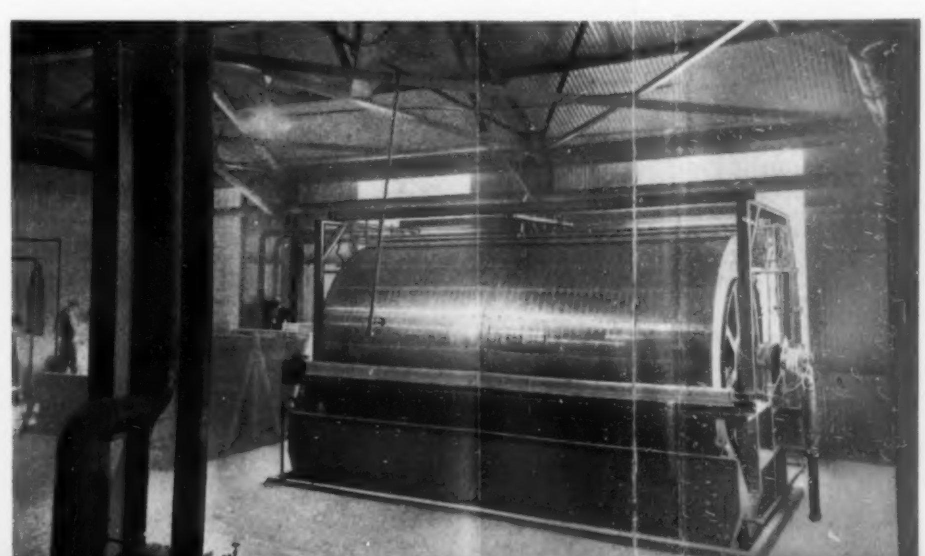


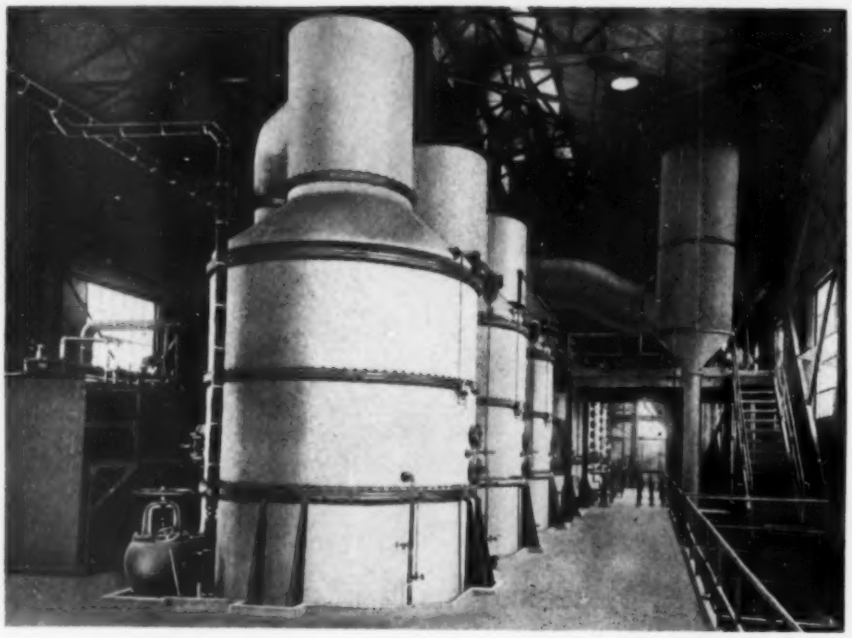
ring by h
last three

ice is heated to about 220 deg. F. before passing to settlers. The three heaters
have welded steel bodies, provided with expansion joints

6 Continuous vacuum filter in which juice is recovered from muds and the mud cake is washed to remove available sucrose. Spent muds are used as fertilizer

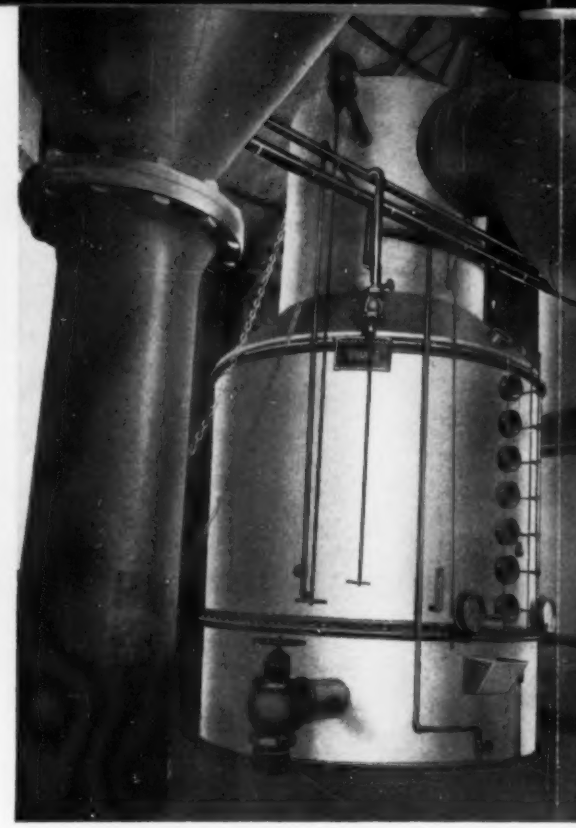




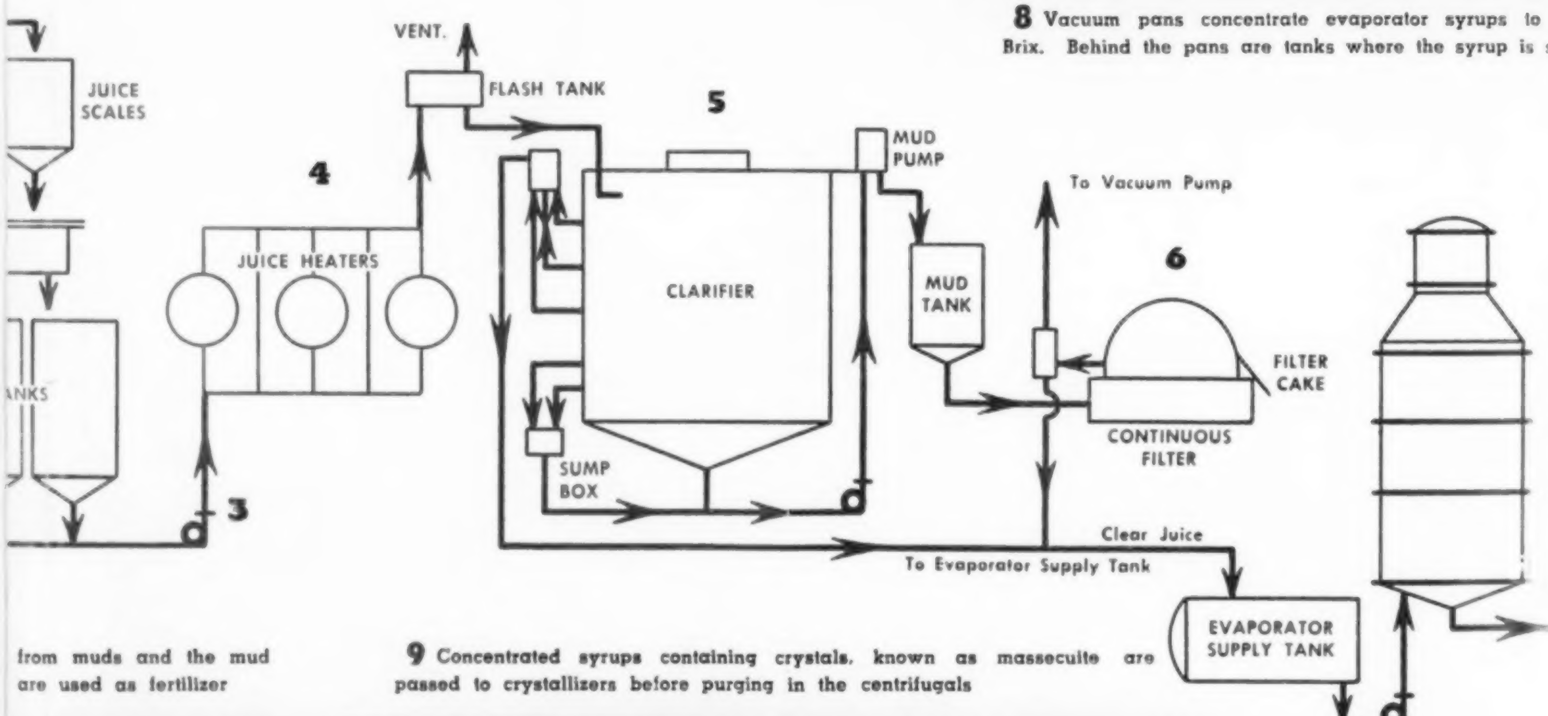


Clear
station

7 Quadruple effect evaporator served by a counter current barometric condenser. Juice enters at 13 deg. Brix and leaves the evaporator at 60 to 65

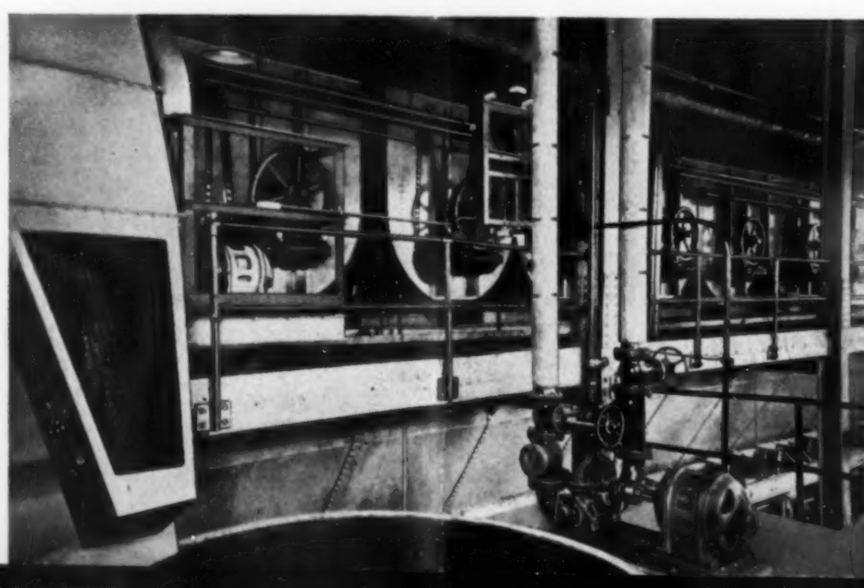


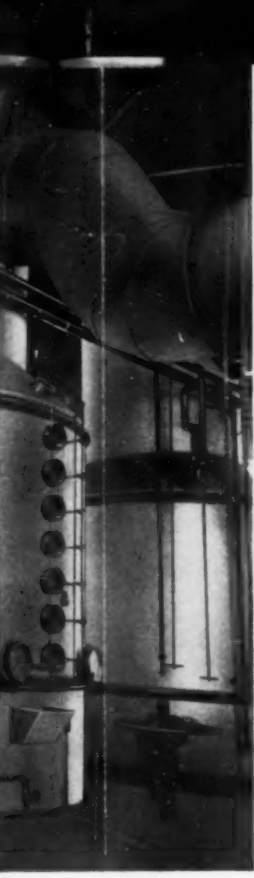
8 Vacuum pans concentrate evaporator syrups to 9
Brix. Behind the pans are tanks where the syrup is st



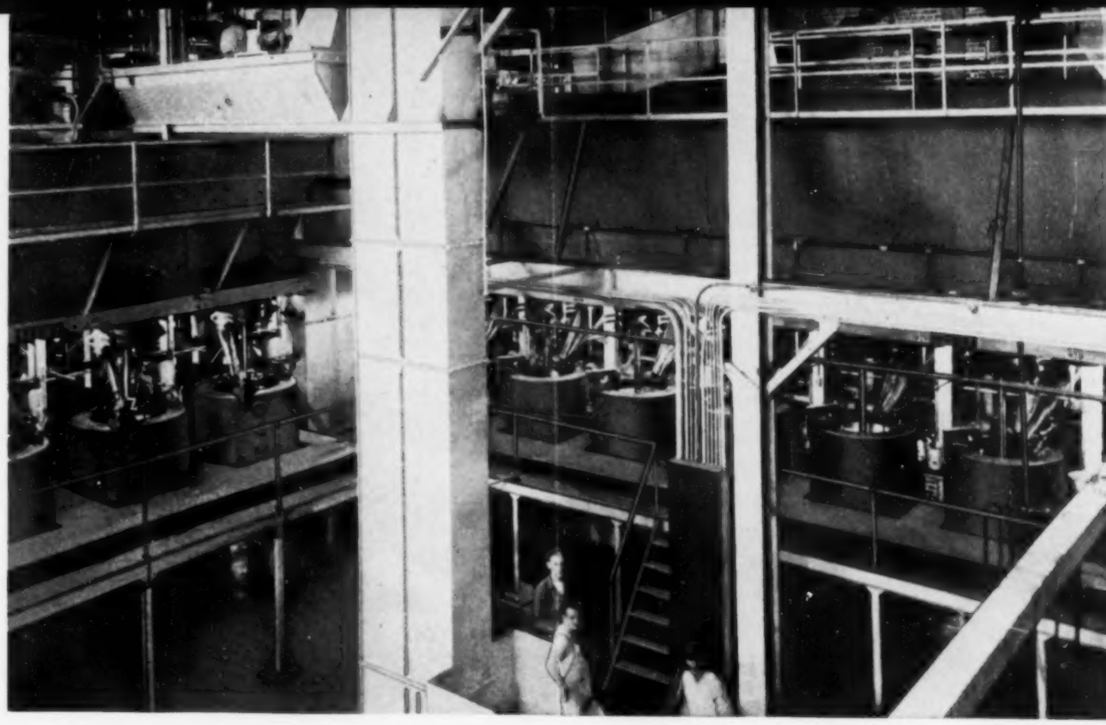
from muds and the mud
are used as fertilizer

9 Concentrated syrups containing crystals, known as masseculte are passed to crystallizers before purging in the centrifugals

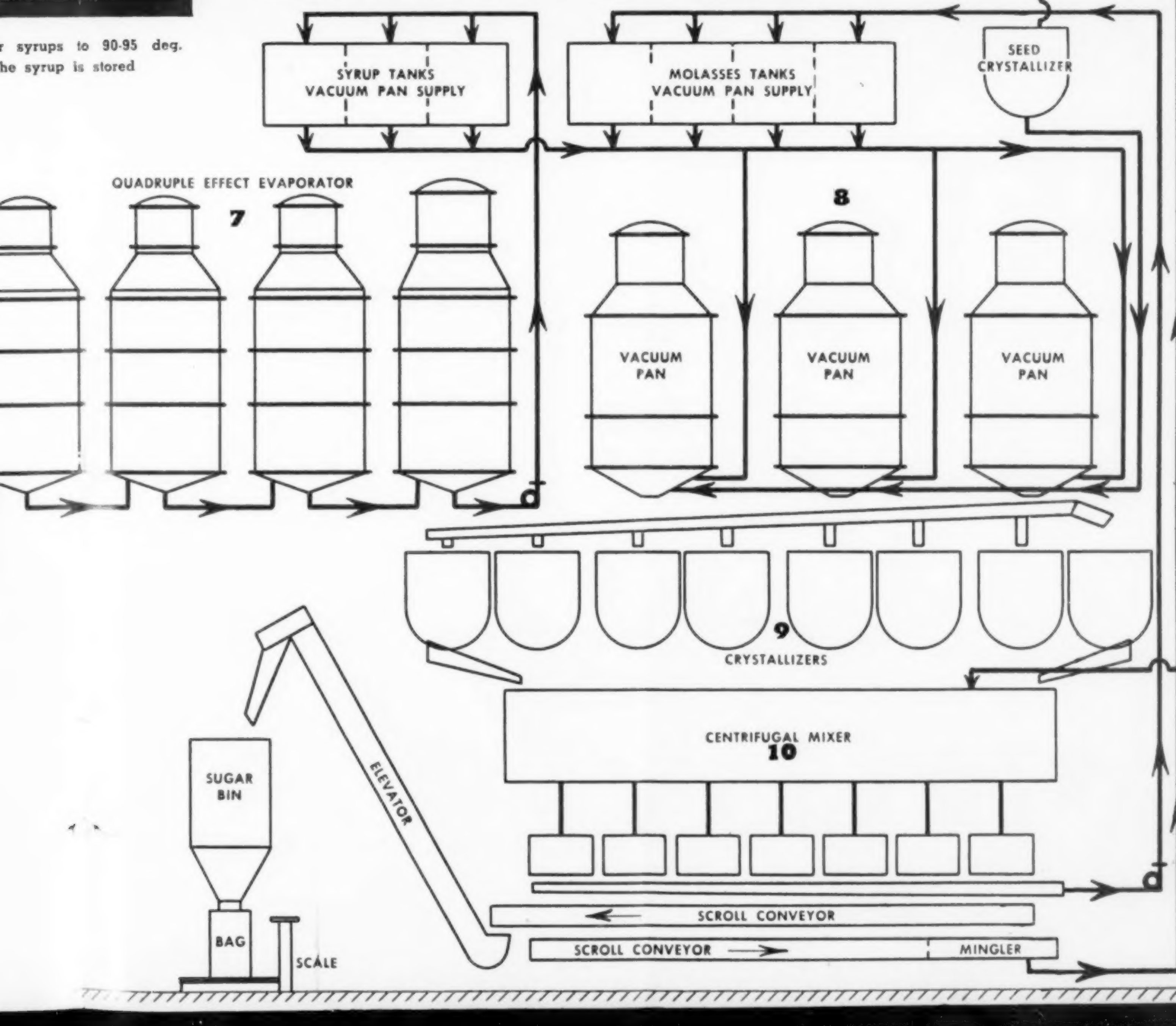




r syrups to 90-95 deg. he syrup is stored



10 For purging the sugar, there is a battery of ten centrifugals, four for first sugars and the balance for low grades. They are driven from a back counter shaft



Timesaving Ideas for Engineers

Chem & Met PLANT NOTEBOOK

CHART FACILITATES CALCULATION OF ROOTS AND POWERS OF WHOLE AND FRACTIONAL NUMBERS

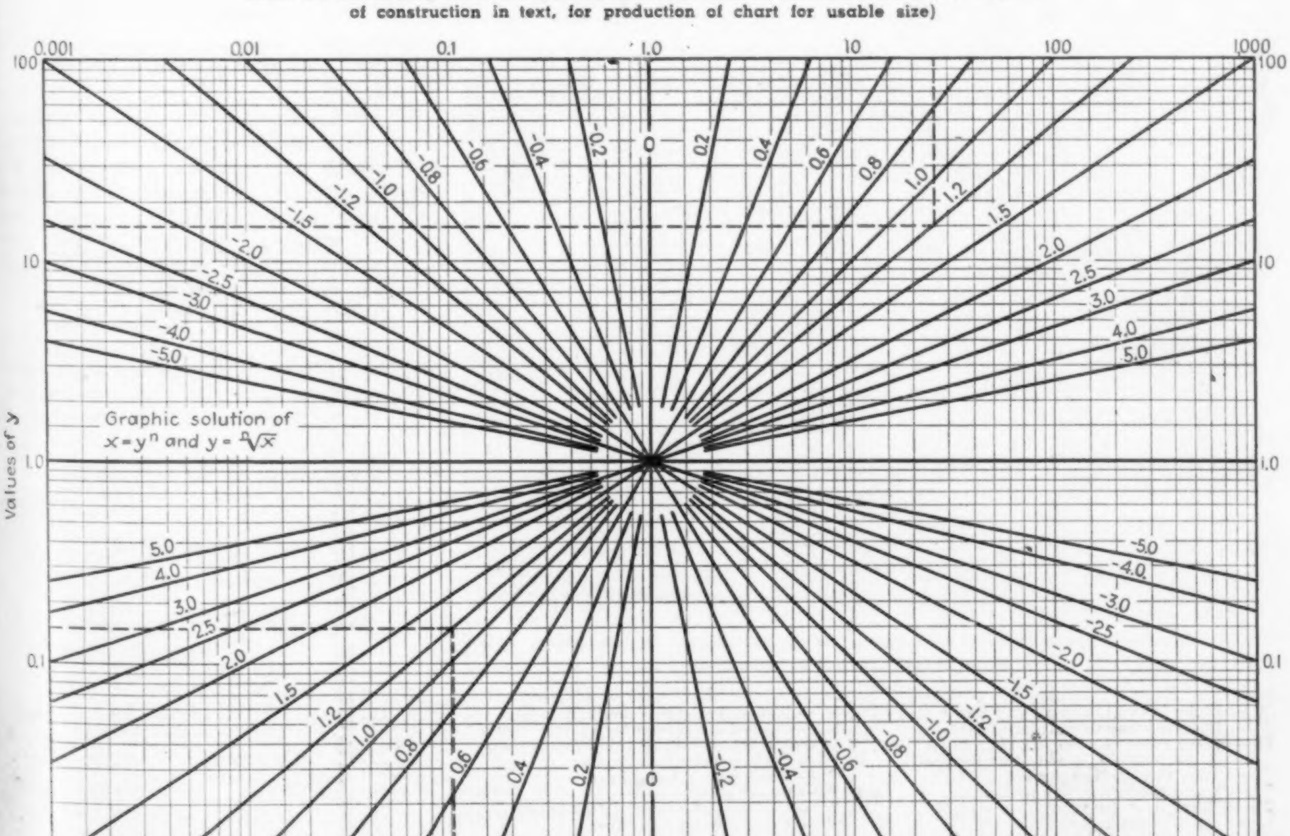
M. G. MASTIN *South Charleston, W. Va.*

ENGINEERS who do much calculating are frequently faced with the need for computing whole or fractional powers of whole and fractional numbers. This is not difficult to do with logarithms or a log-log slide rule, provided the calculator remembers the tricky procedure in the case of fractional numbers. The accompanying chart is presented, either as a mistake-proof method of performing the actual computation, or as a guide to prevent mistakes when using logarithms. In the size reproduced here the chart is too small for use in computation, but it will serve adequately in guiding the user of logarithms. For those who wish to make their own charts to larger scale, the method is simple, and excellent results can be obtained with a chart of some such size as used by the author, namely, 11 x 17 in.

The chart is based on the well known mathematical law that an expression of the form $y = x^n$ when plotted on logarithmic paper will give a straight line with slope equal to n. For greater convenience this chart is reversed to the form $x = y^n$, or $\sqrt[n]{x} = y$, so that the value of n becomes the reciprocal of the slope. In laying out the chart, take a sheet of log paper big enough to give the desired range of x and y. If necessary, this may be accomplished by pasting several sheets together. Through the point (1,1) draw lines for n with slopes equal to $1/n$. For example, the line for $n = 0.2$ has a slope of 10/2, and that for $n = 5$ has a slope of 2/10. As in the chart shown here, the signs of the various n lines are controlled by the quadrant in which they occur. Additional n lines may be added, of course, although a large number is not needed since interpolation is easy. Interpolation between n lines is linear when carried out along a horizontal line of the chart, as will be evident from a consideration of the way in which the n lines are originally determined.

Use of the chart is illustrated by the examples worked out with dotted lines. For instance, $15^{1.2} = 26$ and $0.15^{1.2} = 0.105$. Conversely, $\sqrt[1.2]{26} = 15$ and $\sqrt[1.2]{0.105} = 0.15$.

Chart for calculating roots and powers of whole and fractional numbers (see method of construction in text, for production of chart for usable size)



Plastic Insulation Tip

J. O. G. GIBBONS *Mechanical and Electrical Engineer, Bloomfield, N. J.*

WHEN INSULATING boilers, tanks and other vessels, used in the chemical industry, it is often desirable to use an insulation which can be applied in plastic form. It is generally assumed, in order to get a satisfactory job which will stand up under operating conditions, that it is necessary to use some reinforcing material such as wire mesh, to keep the insulation together. This is assumed to be

true especially where the vessel is subject to considerable changes in temperature.

In the case of some plastics, however, reinforcing mesh can be safely dispensed with, provided that the job is correctly done. This permits a considerable saving, not only in material, but also in the cost of application.

One of the great troubles with plastic insulation, as generally applied, is that it is put on in a solid sheet, so that when the tank body expands and contracts under the influence of temperature changes, the bond is broken between the metal and the insulating sheet, which has nothing to hold it together, except its own coherence.

If the insulating material is first applied in small individual dabs, preferably thrown on with some force and then allowed to dry, the area of each piece will be so small that the expansion and contraction of the metal in that small area will be negligible, and the bond will not be broken. After the material has firmly set these small dabs will act as effective anchors for the main coat, which can be spread on solid.

Of course, this method is only satisfactory with an insulating plastic which will set hard, but with the kind of material suited to such treatment, it has been found to be highly satisfactory.

Static Elimination

RECENT tests conducted in the powder plant of a well known chemical company have shown that a static electric charge as high as 37,000 volts may be generated by the V-belt of a 25 hp. motor. Tests were conducted with a General Electric electrostatic voltmeter, and the experimenters examined the static effect produced by conveyor and motor belts, rubber-tired trucks and actual walking on floors. In the motor belt test the 20,000 volt meter went off scale, the actual voltage of about 37,000 volts being estimated by observation of the spark. Another test indicated the generation of 6,000 volts simply by walking across the carpet of an office.

As a result of these preliminary tests, others were conducted, and the company investigated and adopted conducting belt dressings and numerous other static eliminating means. The experiments serve as a reminder of the likelihood of static charges and suggest the desirability of reconsidering the well known means of reducing static hazards, and looking into the newer ones, such as the use of the new conducting rubber compounds for truck tires, shoes, belts, hose and other similar applications where charges can accumulate.

NEW APPARATUS DETERMINES HEAT TRANSFER COEFFICIENTS FOR CONDENSING VAPORS OF VARIOUS ALCOHOLS

D. F. OTHMER and R. E. WHITE *Polytechnic Institute of Brooklyn, Brooklyn, N. Y.*

AT THE New Orleans meeting of the American Institute of Chemical Engineers, a new apparatus for determining film coefficients of heat transfer from vapors to metal surfaces was described. Simple and compact, as shown in Fig. 1, it gives in a few hours with small amounts of liquid the coefficients over a range of temperature differences and with an accuracy sufficient for any design work. By flowing four streams of cooling liquid from left to right, and four streams oppositely, in eight passages drilled longitudinally in a brass bar, an isothermal condensing surface and uniform temperature drop result which minimizes errors. So also do the new method of measuring the surface temperature used, and the reduction of vapor velocity to the constant value of normal approach.

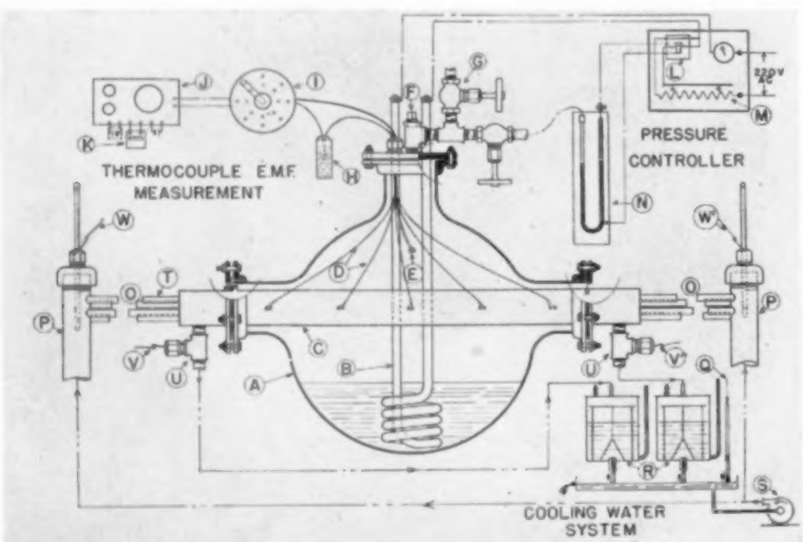


Fig. 1—Diagram showing arrangement of apparatus used in determining rate of condensation of vapors

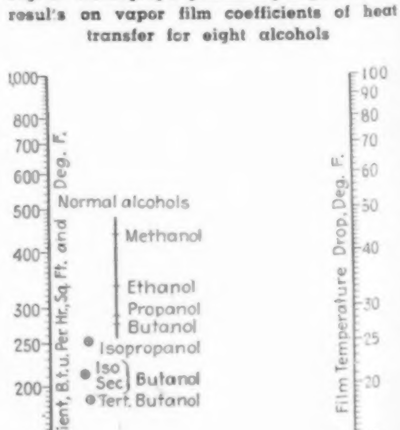
A — Boiler (special 22 liter Pyrex flask)
B — Electric immersion heater (5 kw.)
C — Condensing surface (2 in. brass bar, drilled for eight ¼ in. water passages)
D — Tube thermocouple leads
E — Vapor thermocouple junction
F — Filling inlet (plugged)
G — Vapor outlet valve
H — Ice bath for cold junction
I — Selective switch for thermocouples
J — Potentiometer (Type K, L & N)
K — Galvanometer
L — Relay (Struthers-Dunn)
M — Rheostat (Cenco-Forsythe)
N — Control manometer for vapor pressure
O — Rubber connecting tubes (not shown)
P — Cooling water feed headers
Q — Fresh cooling water inlet
R — Orifice meters
S — Cooling water recirculating pump
T — Cooling water feed tubes
U — Cooling water outlets
V, V′ — Cooling water temperature difference thermocouple cold junctions
W, W′ — Cooling water temperature difference thermocouple hot junctions

At the atmospheric boiling point of methanol, ethanol, *n*-propanol, and *n*-butanol, the determined condensing film coefficients (H) give parallel straight lines against temperature drop (ΔT) on a logarithmic plot; and at constant ΔT, the log of the coefficient also is a straight line when plotted against the reciprocal of the number of carbon atoms in the alcohol (N). For the straight chain alcohols with H in B.t.u. per sq.ft., hr. and deg. F. temperature difference, and ΔT in deg. F., the data may be represented as

$$\log H = \frac{1}{3N} + \frac{11 - \log \Delta T}{4}$$

The data for the normal alcohols substantiate the Nusselt equation; although there is an unexplained divergence in the results for branched chain alcohols which, however, also give straight lines on a log plot. To facilitate use the values in the original log plot are presented in the nomographic chart of Fig. 2.

Fig. 2—Nomograph presenting experimental results on vapor film coefficients of heat transfer for eight alcohols



Technical, Industrial, Personal

RESEARCH FOR INCREASING SUPPLY OF DRYING OILS

Washington is trying to develop new drying oil supplies. Much more aggressive research plans are being carried out by several units of the Department of Agriculture. Active cooperation with industry is also being undertaken, even on some large scale development projects.

The Department also is convinced that 1941 and 1942 crops of oilseeds and related materials must be stimulated. Modifications of the soil conservation program have been made to permit conversion of much soybean acreage from a hay to a bean basis. Formerly this would have penalized the grower by loss of his Soil Conservation bonuses.

The Department is also moving aggressively to develop castor bean seed supply for next year. The program covers 11 counties near Dallas, Tex. Seed is being supplied for this year's crop with the expectation that the result will be much increased seed supply for next year. One estimate indicates that 1,700 acres planted this year may develop seed for a quarter million acres of crop possibility next year.

Perhaps most serious need for new work is in the field of peanut processing. Unless effective oil and meal (or flour) projects can promptly develop, there will be large surpluses of peanuts and at the same time unsatisfied demand for peanut oil. The Department of Agriculture is trying to bridge this gap.

LUNDELL ELECTED PRESIDENT OF A.S.T.M.

G. E. F. Lundell, chief of the chemistry division of the National Bureau of Standards, was elected president of the American Society for Testing Materials at its annual meeting held last month in Chicago. Dean Harvey, of the Westinghouse Electric & Mfg. Co., was elected vice-president. Elected to the executive committee were Arthur W. Carpenter, of the B. F. Goodrich Co.; T. A. Citch, of the Bureau of Standards, Los Angeles; Carl D. Hocker, of the Bell Telephone Laboratories; J. L. Miner, of the Atlas Luminite Cement Co., and E. W. Upham, of the Chrysler Corp.

INSTITUTE OF GAS TECHNOLOGY AT ILLINOIS TECH

Illinois Institute of Technology, Chicago, as a result of an extensive survey conducted among leading colleges and universities, has been selected as the site, and its staff and administrative officers, the administrators of a projected Institute of Gas Technology. Seventeen gas companies are members of the organization group and the decision to found the Institute came as a result of two years investigation by a committee of the industry headed by Frank C. Smith, president of the Houston Natural Gas Co.

Initial financing will provide funds for operating and maintenance expenses of at least $100,000 per year for a period of ten years. The purpose of the Institute is to conduct a comprehensive program of graduate instruction leading to the Master of Science and Doctor of Philosophy degrees. Operation is scheduled to begin in September and from five to ten fellowships will be granted students for the first year.

NEW PREPARATION PROTECTS AGAINST MUSTARD GAS

Chemical Warfare Service has developed a decontamination agent which laboratory tests have shown will protect shoes from the effects of mustard gas. Production of the preparation already has been started in five private establishments and the Service announces plans to greatly expand output through letters of intent to these and other manufacturers.

The new preparation is a specific neutralizing compound in paste form. Packed in tins similar to shoe polish cans, it is applied to shoes by soldiers about to enter a suspected area. Analysis of the preparation is, of course, considered a military secret.

Contracts totaling $600,000 have been awarded these corporations: Baldwin Laboratories, Seagertown, Pa.; Ernst Bischoff Co., Memphis, Tenn.; National Oil Products Co., Cedartown, Ga.; Globe Crayon Co., Barberton, O.; R. M. Hollingshead Corp., Camden, N. J. In addition to expanding these orders, CWS plans also to order additional supplies from Vortexal, Saugus, Mass.

A.C.S. TO MEET IN ATLANTIC CITY IN SEPTEMBER

The 102d meeting of the American Chemical Society will be held in Atlantic City, Sept. 8–12 with the Philadelphia Section in charge of the meeting. Seymour W. Ferris, chief chemist of the Atlantic Refining Co., has been appointed chairman of the general committee. More than 5,000 chemists, chemical engineers, industrialists, educators, and representatives of allied fields are expected to attend the sessions which will be keyed to the chemical industry's all-out effort to speed defense.

Seventy-eight sessions, at which research in practically every sphere of pure and applied chemistry will be reported, are scheduled by the eighteen divisions of the Society. Seventeen special symposia will deal with a wide range of current scientific investigation.

EXHIBITORS MAKE RESERVATIONS FOR CHEMICAL SHOW

The Exposition of Chemical Industries which is held every second year at Grand Central Palace, New York, is scheduled to open this year in the week beginning Dec. 1. This will be the eighteenth exposition and early in June it was reported that 95 percent of the exhibiting space have been contracted for, which indicates the interest manufacturers are taking in the forthcoming event. The rise in general business, to which is added the requirements of the defense program, makes this clearing house of information about materials and equipment especially important this year when many usual channels of supply have been diverted. At the 1939 exposition, more than 40,000 visitors were registered and it is anticipated that this number will be considerably increased this year.

CORNELL LAYS CORNERSTONE FOR CHEMICAL ENGINEERING HALL

The cornerstone of Cornell University's new $700,000 Olin Hall of Chemical Engineering was laid on June 14, during the annual alumni reunions, before a distinguished gathering of trustees, faculty, alumni, and representatives of the organizations engaged in construction of the building. In the absence of the donor, Franklin W. Olin, the principal address was delivered by his son, John M. Olin with another son, Spencer T. Olin also in attendance. The building is scheduled for completion in the fall.

NEW CHEMICAL COMPANY FORMED BY RUBBER INTERESTS

A new Canadian corporation, Naugatuck Chemicals, Ltd., has been formed by the Naugatuck Chemical Division of the U. S. Rubber Co. and the Dominion Rubber Co., Ltd. of Canada. The new corporation will engage in the manufacture of aniline oil, accelerators, anti-oxidants, and other rubber-making chemicals. Manufacturing operations will be at Elmira, Ontario, which is close to the main rubber center in Canada.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

Shortages of chemicals and plastics have increasingly troubled Washington during the past month. It is evident that the speed-up for defense is going to create many shortages not previously anticipated. The revised priorities critical list carries the names of many chemicals not heretofore subject to any regulatory action.

Most other basic supplies and facilities are also short. Any reader of the daily paper knows about the bitter controversy as to the question of power shortage, of the appeals to buy coal early, and of the problems of petroleum distribution (discussed more fully below). It is also becoming evident that the control of all important industrial metals is producing serious industrial dislocations, both immediate and in prospect. The transportation system by water has already broken down so completely that allocation of ship space is already under way. Shortages of motive power and of freight cars are feared. Already priority for steel supply to speed-up construction of this railway equipment has been authorized.

These situations have forced reorganization of O.P.M. and a long step toward a replica of the 1917 War Industries Board. Further conversion to commodity basis for Washington controls is going to be necessary as the acute problems of each industry develop.

Conversion of industry to a full war basis is now frankly discussed and official Washington expects to ask for and secure from Congress plenty of authority to carry out even the most drastic readjustments by order, whenever voluntary cooperation is not prompt and extensive enough to satisfy. It is generally admitted that the United States must get ready for a long war.

Petroleum Plans

The taking of tankers from the petroleum industry has created a real shortage which is mild at the moment but serious in prospect for the northeastern quarter of the United States. Secretary Ickes is acting as petroleum coordinator for guidance of the industry. Complete recasting of the distribution system of all companies may be necessary. Every unit will be so organized as to feed northeastward every possible gallon of fuel oil and gasoline. Interchange of facilities and products among the principal companies will distribute the shortage over a wide area so that the percentage cut can be made as small as possible on each industry and each privately owned oil burner and motor car.

Much of the blame for present trouble rests on railroads, railroad workers, and a limited number of groups competitive with petroleum or petroleum pipe lines. When cold houses and gasless automobiles become a problem, this situation (which has centered in Georgia and with one Southeastern railroad) is going to bring a major criticism of that industry.

It is not expected that Congress will listen sympathetically to the complaint that certain railroad workers will be thrown out of jobs by the building of a crude oil or gasoline pipe line. It is too obvious that many times that number of persons would be either cold, without transportation, or perhaps without jobs because the oil and its products did not reach necessary destinations. The claims of some of these railroad groups are so absurd that they are defeating themselves with Congressmen responsible for holding hearings. But the delay continues to be significant.

Magnesium and Aluminum

Tremendous boosts in plans for light metals were announced during June. The new O.P.M. recommendations for magnesium will require a capacity to product 400 million pounds per year, which is 13 times the estimated production of 1941. But it is evident that neither this nor the tremendously expanded aluminum program can be realized unless some sort of a new power supply can be developed.

To achieve larger magnesium output, further expansions are contemplated by both Dow and Permanente. Negotiations are in progress with seven other companies, all of whom, officials hope, will proceed from the present blue print and pilot plant stages into commercial production soon. Several of these companies will use the Dow process. At least three other processes are also proposed by some of these companies.

Near the end of June O.P.M. in reply to Congressional committee criticism announced its recommendation that the government build eight more aluminum reduction plants. Locations in Arkansas, near Grand Coulee, in upper New York State, Alabama, California, and North Carolina are suggested. These and other plants already under contract for construction are reported to provide 1400 million pounds of annual capacity. But it is known that at least two billion pounds of capacity will be required for the projected aircraft program and for other necessary defense uses.

One of the serious difficulties of Washington, which is highlighted by the light metal forecasts, is the glib way in which enlarged programs are "adopted". It is so easy for some official in high position to say, "We shall now do this . . . ." The result may be a complete disorganization of some of the interlocking supply, equipment, or material projects of equal importance to other units of the Army and civilian activity. This grandiose philosophy is probably at the root of much of the serious commodity shortage, some of which may never actually materialize unless the equipment building capacity of the country is enlarged beyond present foreseeable levels. But despite this, there is no doubt that every possible means for expanding both magnesium and aluminum capacity will be pressed.

Commodity Sections

OPM's realignment of operations late in June is intended primarily to streamline relations between industry and Government and to provide a "one-stop" service for the manufacturer who wants either advice or help. Commodity sections are to be set up within OPM, containing representatives from the defense agency's principal divisions —purchases, priorities, production, labor, and civilian allocation. Industry committees are to be selected, under OPM's guiding hand, to act as a clearing house and liaison with Washington.

In theory, at least, individual manufacturers will take their troubles to their industry committee which will lay them before the commodity unit for a decision. The commodity unit will have power to act within the broad general policies established from the "top." The procedure will work the other way, with OPM passing along to commodity units policies and ideas for translation to industry through the committees.

The system is frankly patterned after the War Industries Board idea of the last war. Chief difference noted now is that industry committees are not intended to be "business agents" per se, but rather a "clearing house" for shuffling problems between OPM and producers.

At least one chemical commodity section is to be created, and probably only one. The present defense officials with whom the chemical industry is now familiar will staff this unit with Dr. E. R. Weidlein from OPM's Production Division, the probable chief. It is expected, however that more than one committee will be set up in the various divisions of the industry. This was all in a very elastic stage early in July.

One important aspect of defense does not fall within the realm of this new setup. Prices still are the exclusive problem of Leon Henderson and while industry committees may work with OPACS on prices, the subject will not be handled by the commodity units.

Munitions Plants

The Army's second, and larger, chain of munitions plants began unfolding in big chunks during June. By the end of the month, the total allotted to new plants and expansion of those in the first program had passed the half-billion dollar mark although many of these are not yet under contract. Money for plants in the new program

comes indistinguishably from either the Army's own "expediting of production" account or from the British lend-lease appropriation.

Emphasis in the first plants announced is on high explosive production and shell loading, as well as basic raw materials for explosives. Thus, two new ammonia plants were announced for Monroe, La., and Louisiana, Mo., each to cost $16,750,000 and have a daily capacity of around 150 tons, and an $18,500,000 expansion was arranged for the duPont-operated ammonia works at Morgantown, W. Va., more than doubling its capacity.

The picric acid works deleted last fall from the original plant list now has been located at Marche, Ark. It will cost $8,000,000 and will be operated for the Army by a company not yet announced. Another new plant for TNT, DNT and tetryl production will be located at Chattanooga, Tenn., at a cost of $39,000,000. Size of the TNT factories at Sandusky, O., and Weldon Springs, Mo., both are being expanded to roughly three times their originally scheduled size, and TNT, DNT and tetryl manufacture is being added at the duPont smokeless powder site at Childersburg, Ala., at a cost of $24,675,000.

In connection with the munitions program, the War Department announced on June 24 that Copperhill, Tenn., had been selected as a site for an oleum plant to be used in the manufacture of TNT. Construction of buildings, building installations, purchase of machinery and equipment, is expected to cost about $2,375,000. The plant will be government-owned and privately operated. It will be built adjoining a similar plant of the Tennessee Copper Co. and the Department is negotiating with that company for lease of the land and operation of the plant.

Bulk of the new plant allocation so far, however, is for shell and small arms ammunition assembly. New shell assemblies will be located at Parsons, Kan., Texarkana, Tex., Minden, La., and Jacksonville, Ark., and new small arms plants at St. Paul, Minn., Salt Lake City, and Des Moines, Ia. Expansion also is programmed for all five the first program shell assembly lines at Union Center, Ind., Wilmington, Ill., Milan, Tenn., Ravenna, O., and Burlington, La.

Equipment Priorities

Repair and maintenance materials and chemical engineering equipment required for uninterrupted operation of vital process industries and public services were given a blanket form of priorities July 1 in a formal order from OPACS. The system is designed to provide essential articles ahead of nondefense uses and ahead of allocation for defense production as far as possible. Although the priorities status was promulgated by OPACS, the Priorities Division of OPM will be the administrative agency. The program covers 26 industries, among them, petroleum production and refining; food processing and storing; mining and quarrying; metallurgical plants engaged in production of raw materials; production of chemicals; research.

Applications for priority assistance under this program should be addressed to Edward R. Stettinius, Jr., OPM's Director of Priorities. It is anticipated that standard forms will be prepared for use by industry in obtaining allocation of supplies. It is emphasized that the system shall be used only to obtain necessary materials and equipment. The order specifically states that the program shall not be used "to accumulate excessive inventories or to divert parts still serviceable."

Official definitions supplied by OPACS follow: "As used herein, the term 'maintenance' means the upkeep of property and equipment, and the term 'repair' means the restoration of property and equipment to a sound state after wear and tear, damage, destruction of parts, or the like. These terms include replacement of parts which have been worn out, damaged or destroyed, but do *not* include replacement when the new part or parts represent a changeover in model, the introduction of superior type equipment to replace useable equipment of an older or inferior type or design or a substitution more extensive than that is necessary to replace the part or parts that are worn out, damaged or destroyed."

(*Continued on Page* 124)

FIRST PROGRAM

TYPE	LOCATION	COST	OPERATOR	CONTRACTOR
Smokeless powder	Charlestown, Ind	$74,000,000	duPont	duPont
Smokeless powder	Radford, Virginia	36,390,000	Hercules Powder	Hercules
Smokeless powder	Childersburg, Ala	48,000,000	duPont	duPont
Bag loading	Charlestown, Ind	17,600,000	Goodyear Eng. Corp.	Winston Bros. Co.; C. F Haglin & Son, Inc.; Missouri Valley Bridge & Iron Co.
Bag loading	Pulaski, Va	9,376,000	Hercules Powder	Mason and Hanger Co.
Bag loading	Childersburg, Ala	9,437,000	Brecon Loading Co. (Coca-Cola sub.)	Sullivan, Long & Hagerty Algernon Blair
TNT, DNT-Tetryl	Wilmington, Ill	31,000,000	duPont	Stone & Webster
TNT-DNT	Weldon Springs, Mo.	11,325,000	Atlas Powder	Frazer-Brace Engineering Co.
TNT-DNT	Sandusky, Ohio	9,388,000	Trojan Powder	E. B. Badger & Sons Co.
Ammonia	Morgantown, W. Va.	15,000,000	duPont	duPont
Ammonia	West Henderson, Ky.	13,600,000	Solvay Process Co.	
Ammonium nitrate	Muscle Shoals	6,500,000	TVA	TVA
Small arms ammunition	Kansas City, Mo	21,000,000	Remington Arms	Foley Brothers; Walbridge Aldinger Co.
Small arms ammunition	St. Louis, Mo	30,419,000	Western Cartridge	Fruin-Colmon Construction Co.; Fruco Const. Co.; Missouri & Massman Const.
Small arms ammunition	Denver, Colorado	24,800,000	Remington Arms	Broderick & Gordon
Ammunition loading	Union Center, Ind	11,500,000	Todd & Brown	Bates & Rogers
Ammunition loading	Burlington, Iowa	13,735,420	Day & Zimmerman	A. Guthrie & Co.; A. Johnson Const. Co.
Ammunition loading	Ravenna, Ohio	16,790,000	Atlas Powder	Hunkin-Conkey Const. Co.
Ammunition loading	Wilmington, Ill	14,500,000	Sanderson & Porter	Sanderson & Porter
Ammunition loading	Milan, Tenn	8,514,000	Proctor & Gamble	H. K. Ferguson; Oman Const. Co.
Toluol	Bay Town, Texas	11,857,000*	Humble Oil & Refining Co.	Humble Oil
Activated carbon	Fostoria, Ohio	1,000,000	National Carbon Co.	National Carbon
Activated carbon	Zanesville, Ohio	1,000,000	Barneby-Cheny Co	Barneby-Cheny Co.
Edgewood Arsenal Exp.	Edgewood, Md	5,900,000	Chemical Warfare service	Chemical Warfare Service
Powder expansion	Indian Head, Md	3,490,000	U. S. Navy	duPont

* Includes $1,097,000 to equip existing plant under five-year amortization.

SECOND PROGRAM

Ammonia	Monroe, La	$16,750,000	*	*
Ammonia	Louisiana, Mo	16,750,000	*	*
Picric acid	Marche, Ark	8,000,000	*	*
TNT-DNT-Tetryl	Chattanooga, Tenn	39,000,000	*	*
Small arms ammunition	St. Paul, Minn	30,000,000	*	*
Small arms ammunition	Salt Lake City, Utah	30,000,000	*	*
Small arms ammunition	Des Moines, Iowa	30,000,000	*	*
Ammunition loading	Parsons, Kans	35,000,000	*	*
Ammunition loading	Texarkana, Texas	45,500,000	*	*
Ammunition loading	Minden, La	29,000,000	*	*
Ammunition loading	Jacksonville, Ark	33,500,000	*	*

EXPANSION OF FIRST PROGRAM PLANTS

TNT-DNT	Sandusky, Ohio	$20,297,000		
TNT-DNT	Weldon Springs, Mo.	14,131,060	Atlas Powder	Frazer-Brace
TNT-DNT-Tetryl	Childersburg, Ala	24,675,000		
Ammunition loading	Union Center, Ind	9,000,000		
Ammunition loading	Wilmington, Ill	8,575,000		
Ammunition loading	Milan, Tenn	2,645,350	Procter & Gamble	H. K. Ferguson; Oman Const. Co.
Ammunition loading	Ravenna, Ohio	8,100,000		
Ammunition loading	Burlington, Iowa	5,344,996	Day & Zimmerman	A. Guthrie & Co.; Al. Johnston Const. Co.
Ammonia	Morgantown, W. Va.	18,500,000		
Small arms ammunition	St. Louis, Mo	58,850,000		
Oleum	Copperhill, Tenn	2,375,000	Tennessee Copper Co.	

* Not announced.

INDUSTRIAL ACCIDENTS IN GERMAN CHEMICAL PLANTS REPORTED TO BE ON THE INCREASE

Special Correspondence

FIGURES are not published, but the last two annual reports of the safety committee of the German chemical industry indicate that the number of industrial accidents in the Reich is on the increase. This is probably due in part to speeded up production, employment of less skilled labor, and workers tired from war strain and food shortages. For military reasons news of industrial accidents, as at powder factories, nitroglycerine plants or other war important industries never has been published in Germany, but reports of the "Berufs-Genossenschaft" contain growing numbers of discussions of safety measures in war industries and analyses of various industrial accidents that might have been prevented. One example is the scrap metals industry which always has had to exercise unusual precautions when handling scrap which occasionally includes unexploded hand grenades, shells and mines, some of them gathered from old World-War I fighting areas.

Within individual plants in dangerous units urgent warnings that cloth blackout window curtains be replaced with non-flammable materials like "Igelit" and that the same be done at entrances and exits where light "sluicing" chambers have been installed indicates that there have been some fires on that account. Precautions also are being issued for greater care in handling newly developed substitute materials for all possible reactions of such materials are not yet known. Recently as a result of increased accidents a government decree for the chemical and pharmaceutical industry advised greater caution in handling sodium metal and other chemicals. Here packaging shortages and innovations, curtailed transportation facilities and the like have been added to the human factor.

To lessen one danger in the laboratory as well as to conserve supplies, the Reich Health Office in Berlin has been trying to encourage use of methylene chloride in the place of ether as a solvent in laboratory work. In the "Reichs Gesundheits-Blatt" it is pointed out that despite its higher cost —the price of ether in the meantime has advanced, too, as the cost of alcohol has risen—it has the advantage of being generally less dangerous, less flammable, and less soluble in water or hydrochloric acid than ether. On the other hand, some laboratory experts point out that the change would involve difficulties in revaluating experimental data now based on ether.

Reclaiming silver from used commercial photographic fixing baths is claimed to be easier with a new IG product "Agfargan," described in the "Agfa-Roentgen-Blaetter." Since three-quarters or more of the silver from the film comes out in the fixing bath, it is stated that about 125 grams silver could be reclaimed from a 12 liter tank. Electrolysis has been tried but found too expensive. Precipitation through other metals has been impossible because some of the latter were not available. Precipitation with hydrogen sulphide or its salts has been tried but has not been too successful because of its injurious effect on any photographic processes going on in neighboring rooms. Reduction with ferrohydroxide from ferrosulphate and sodium hydroxide also has been tried, but the resulting precipitate contains less than 40 percent silver, and has thus been less valuable than the precipitate from using "Agfargan"; 2.4 grams of the preparation in powder form recovers 1 gram of silver per liter of fixing bath with a precipitate being formed in from 10 to 12 hours. A new apparatus which is being used in conjunction with the precipitation process makes possible a quick analysis of the amount of silver present in any used fixing bath. Along with silver precipitation attempts have been made to regenerate sodium hyposulphite of the fixing baths, but so far they have been unsuccessful.

A new dye, alizarin chrome blue FFG, which concludes a new series of brilliant chrome red and chrome yellow colors, is now being produced in the Reich. The new I. G. Farben product, which is characterized by an unusually clear and brilliant blue color, is claimed to be quite soluble and suitable especially for dyeing mixed wool and cell-wool materials. "Dullit RK" has been found to be a good substitute to dull shiny parts of fabrics, chiefly wool-type "wollstra" gabardine.

Magnesite (magnesium carbonate), chief raw material for magnesium production abundantly available in central Europe, is being processed chiefly by I. G. into "Elektron" metal containing aluminum, zinc, and manganese, and "Hydronalium" metal. Second most important German producer is the potash Wintershall concern, which undertook production of "Magnewin" since 1936 on the basis of its own potash supplies. The publication "Das Reich" claims that Germany's production—more or less state-subsidized—now exceeds the 1938 level, which was then estimated at 14,000 metric tons. Actual production figures are, of course, kept strictly secret. In Italy the Fraschini automobile and Montecatini chemical interests have tried manufacturing the light metal from calcium-magnesium carbonate "dolomite" available in northern Italy. The southern axis partner's magnesium production is estimated to be around 1,800 tons a year, although Italians once announced they would have a 3,000 ton capacity by the end of 1941. Besides using dolomite, the Italians in a Montecatini plant on the Ligurian coast are processing magnesium chloride from sea water in a process similar to that used in Norway and by the Dow company in the United States. One of the reasons for the relative abundance of raw material for magnesium in the Greater Reich is that for many years, in Austria especially, magnesite production has been quite high since the material has been used in iron production, and for manufacturing firing bricks.

A new acid resistant "carbon" brick for lining containers is now being produced in Berlin by the Siemens-Plania works. The new Siemens product, called "Kohlenstoff-Stein," as well as a mortar to cement it, is claimed to surpass ceramic brick in that it will withstand hydrofluoric acid and alkaline solutions. Although it is completely resistant to phosphoric, acetic, and hydrochloric acids, to organic substances, lyes, and neutral salt solutions, it is not satisfactory for use with nitric acid or sulphuric acid at higher temperatures.

Steel chrome-nickel alloys with high molybdenum content or silicon-iron cast alloys have shown fair resistance to acid. DRP 691,325 of the "Ruhrstahl A. G." is a new patented hydrochloric acid resistant steel composed of 11 to 18 percent antimony, 0.1 to 0.3 percent beryleium, up to 5 percent molybdenum, and up to 5 percent tungsten. Invented by F. Reiner, the new alloy is claimed to have excellent mechanical properties and to be quite workable. The steel used in its manufacture, however, must have less than 0.5 percent carbon, and less than 0.3 percent sulphur and phosphorus.

With many new light building materials coming on the market, a central research, testing, and standardizing bureau for controling size and quality of brick products has been established in Berlin. Its field covers especially new light bricks made of pumice, and of blast furnace slag with admixtures of limestone, Thomas meal, or of cement. It is planned to increase considerably the Reich capacity for producing light porous bricks of this type.

An easing in the shortages of nitrates for fertilizer use is indicated in a recent decree permitting domestic sale again of "Nitrophoska" fertilizer.

NIAGARA ALKALI AND ELECTRO BLEACHING GAS MERGE

Niagara Alkali Co. and Electro Bleaching Gas Co., two pioneering firms in the field of alkalies and liquid chlorine, announce that they have joined forces beginning July 1 will operate at one organization under the name of Niagara Alkali Co. This move, which involves no change in personnel or policies, has been made to facilitate the operations of the two companies and increase the efficiency of the service each has been giving to customers over a period of approximately three decades.

GAIN IN PRODUCTION OF DYES AND SYNTHETIC CHEMICALS

Production and sales of synthetic organic chemicals last year were of record proportions with sales reaching a valuation of $484,000,000 or an increase of 26 percent over those for 1939, the previous peak. The Tariff Commission has issued its preliminary report on the industry and the details show the extent to which these branches of the chemical industry are expanding. Sales of synthetic coal-tar chemicals were reported at $218,000,000 compared with $185,000,000 in 1939 or a gain of 18 percent while sales of non-coal-tar chemicals in the same period rose from $200,000,000 to $266,000,000 or a gain of 33 percent.

The groups that advanced most in sales value were coal-tar resins, medicinals, and intermediates. In 1940 as in preceding years, about one-half of the output of intermediates and non-coal-tar chemicals, and smaller fractions of the other groups, were not sold as such but were consumed by producers in further processing.

Production of 806,000,000 lb. of coal-tar intermediates in 1940 was 33 percent greater than in 1939. Sales increased even more. Production of phthalic anhydride and phthalic acid increased nearly 31 percent; phenol 40 percent, 72,000,000 lb. being produced synthetically and 24,000,000 lb. from coal-tar crudes. The output of maleic acid and anhydride reached 4,500,000 lb. or more than double that of the preceding year.

The synthetic organic chemical industry employed 2,692 technically trained workers; the gross cost of research was $17,500,000 and the net cost $16,200,000 or 3.3 percent of the sales of all organic chemicals in 1939.

The output of coal-tar dyes moved up to 128,000,000 lb. which was about 8,000,000 lb. over the 1939 total. A comparison of production and sales of

Production, Sale of Synthetic Organic Chemicals

(Production and sales in thousands of pounds; sales value in thousands of dollars.)

Coal-tar chemicals	1939	1940
Intermediates:		
Production	607,175	805,807
Sales	269,084	315,967
Sales value	38,489	46,428
Finished coal-tar products:		
Production	437,867	522,850
Sales	353,604	402,324
Sales value	146,156	171,427
Dyes:		
Production	120,191	127,834
Sales	114,494	122,677
Sales value	70,224	76,432
Medicinals:		
Production	15,188	18,208
Sales	12,932	15,004
Sales value	13,711	17,511
Flavors and perfume materials:		
Production	5,349	5,490
Sales	4,938	5,067
Sales value	4,447	4,759
Coal-tar resins:		
Production	179,338	222,943
Sales	128,420	153,521
Sales value	23,028	33,378
Non-coal-tar chemicals		
Production	3,034,655	3,994,661
Sales	1,532,363	1,989,282
Sales value	199,698	265,544

dyes by classes of application indicates only small changes in distribution.

Resins are of particular interest because of the emphasis on them in national defense. Production last year was reported at 223,000,000 lb. or about 24 percent more than in 1930. Non-coal-tar resin output was 54,000,000 lb. or 60 percent over that for the preceding year.

Production and Sales of Specified Coal-Tar Intermediates in 1940

	Production, Lb.	Sales Lb.	Sales Value
Gamma acid	1,302,585	154,092	$129,224
H acid	4,309,188	....	....
Tobias acid	1,879,169	937,068	501,488
Aniline oil	55,719,733	20,074,178	2,182,948
Benzidine hydrochloride and sulphate	1,626,424	....	....
Benzyl chloride	2,377,768	....	....
Chlorobenzoyl benzoic acid	1,570,790	....	....
Cresol, ortho	1,329,199	1,370,169	152,785
Cresol, ortho-meta-para	16,049,525	16,023,297	1,209,428
Cresylic acid, refined	18,371,261	18,048,382	1,234,113
o-Dichlorobenzene	5,849,618	4,375,884	220,285
p-Dichlorobenzene	15,086,726	14,165,109	1,207,143
Dimethylaniline	7,049,741	....	....
Dinitrobenzene	2,642,074	....	....
Dinitrochlorobenzene	9,753,665	1,786,274	181,001
Maleic acid and anhydride	4,497,216	2,922,619	718,935
Naphthalene, solidifying 79 deg. or above	58,249,891	31,669,868	1,839,601
From domestic crude	52,094,527	....	....
From imported crude	6,155,364	....	....
2-Naphthol-6, 8-disulfonic acid	1,370,964	....	....
Nitrobenzene	69,105,449	....	....
Phenol, natural	23,967,560	23,625,053	2,150,551
Phenol, synthetic	72,187,520	....	....
Phenylglycine, sodium salt	4,195,886	....	....
Phthalic acid and anhydride	57,946,415	28,346,067	3,899,151
Sulfanilic acid and salt	1,941,126	....	....
M-Tolylenediamine	1,081,595	332,214	222,760
Trichlorobenzene	2,498,791	2,618,291	171,828

Production and Sales of Specified Synthetic Coal-Tar Chemicals

Acetylsalicylic acid	6,409,824	6,245,053	$2,861,752
p-Aminobenzosulfonamide	543,802	494,983	670,311
Coumarin, synthetic	245,688	217,634	506,221
Dibutyl phthalate	8,799,528	5,506,098	947,658
Diethyl phthalate	2,306,063	1,869,683	333,167
Diphenylguanidine	1,448,504	1,279,701	427,086
Diphenyl-p-phenylenediamine	1,281,841	....	....
Hydroquinone, photographic grade	1,228,647	935,719	761,748
Methyl salicylate	1,641,571	1,486,791	446,989
Mercaptobenzothiazole	5,438,933	....	....
Salicylic acid	5,068,010	3,075,135	762,564
Sodium salicylate	734,123	684,702	289,803
Textile chemicals	13,175,777	12,751,293	2,792,779
Thiocarbanilide	404,838	....	....
Vanillin	576,708	619,407	1,249,459

Production and Sales Non-Coal-Tar Synthetic Chemicals

Acetaldehyde	201,484,831	....	....
Acetic acid, 100 percent	184,884,866	....	....
Acetic anhydride, 100 percent	256,652,339	....	....
Acetone	201,506,334	121,172,975	$5,571,188
Amines	1,969,441	1,746,288	927,962
Barbituric acid and derivatives	355,509	143,474	733,449
Butadiene	369,089	276,554	98,363
Butyl acetates, 100 percent	86,721,057	78,864,644	5,903,842
Butyl alcohols, 100 percent	164,568,813	61,313,850	4,621,665
Carbon tetrachloride	100,811,330	79,674,547	3,093,415
Chloroform, tech.and USP	3,078,521	2,226,952	415,560
Diacetone alcohol	4,671,512	2,832,591	225,275
Ethyl acetate, 85 percent	75,368,803	60,632,757	3,571,439
Formaldehyde, 40 percent	180,884,573	107,999,713	4,558,666
Geraniol	306,435	275,772	220,432
Isopropyl alcohol	219,925,900	39,673,760	1,563,541
Lactic acid, technical, 100 percent	1,869,365	1,671,237	212,276
Methanol, synthetic	....	159,271,316	5,222,425
Methyl chloride, 100 percent	3,041,661	3,123,484	971,882
Oxalic acid	12,921,227	....	....
Sulfated fatty alcohols, acids, etc	16,201,261	14,782,253	4,021,390
Terpineol	766,705	771,247	157,490

Production and Sales of Certain Synthetic Resins

Coal-tar: Total	222,943,118	153,520,805	$33,378,406
Alkyd resins:			
Maleic anhydride	6,476,883	5,418,875	1,008,835
Phthalic anhydride	91,446,195	42,400,005	7,774,730
Coumarone and indene	24,131,733	22,976,705	1,576,907
Derived from tar acids:			
Cresols or cresylic acid	11,978,763	....	....
Phenol:			
For casting	6,953,103	6,696,008	3,175,589
For molding	26,417,693	25,117,472	7,869,678
For other uses	26,957,636	24,234,563	4,822,729
Phenols and cresols	21,126,005	....	....
Non-coal-tar: total	53,871,245	47,578,845	25,989,933
Urea	21,491,653	19,300,685	7,445,483

STATISTICS ON THE USES OF SPECIALLY DENATURED ALCOHOL, FISCAL YEAR ENDED JUNE 30, 1940

In view of the interest at present taken in industry requirements of chemicals, statistics recently released by the Alcohol Tax Unit, Bureau of Internal Revenue, are especially timely. The Bureau explains that for these compilations, a primary classification has been adopted for specially denatured alcohol according to the basic functions it performs. The principal functions are, first, its use as a solvent, second, its use as a raw material in the production of other chemicals, and, third, its use as a fluid where it neither exercises a solvent action nor enters into a chemical reaction. In addition, small quantities are used as fuels. In the second classification, which is according to products, some products appear more than once. This occurs where alcohol is required to perform two or more functions. For example, dyes are listed under three headings since alcohol is employed as a raw material to produce a dye chemical, as a solvent to purify dyes, and as a solvent to produce a dye solution for the trade.

In a number of processes, some of the alcohol can be recovered and reused. The present release is the first to show separately the amount of new alcohol used and the amount recovered.

Considering merely the new specially denatured alcohol used, it is found that the group in which it is used as a raw material in chemical manufacture is the most important and for the 1940 fiscal year accounted for more than 53 percent of the total. Next came its application as a solvent and thinner for cellulose, resin, and shellac which accounted for more than 16 percent of the total, and third place is held by the group including manufacture of lacquers, varnishes, and plastics which required more than 10 percent of the grand total.

In the present year, industry requirements for specially denatured alcohol have been considerably expanded due to the rise in general industry and to the direct and indirect influences of the defense program. With the opening of smokeless powder plants, demand for alcohol has increased and will become more insistent as these plants reach full capacity operations. It also is probable that a larger than usual proportion of antifreeze requirements for next season will have to be borne by the alcohol industry but recent reports to the effect that new synthetic production of ethyl alcohol was in prospect give assurance that the output in 1941 will be considerably larger than in any previous year and it may be large enough to take care of all needs.

Specially denatured alcohol[1] consumed by kinds of products or uses, fiscal year ended June 30, 1940

Product or use	Amount used: New	Amount used: Reused[2] Wine gallons	Amount recovered for reuse
Cellulose, resin, and related products:			
Lacquers, varnishes, and enamels:			
Cellulose	1,438,752	1,720,887	1,759,700
Synthetic resins (with or without natural resins but containing no cellulose compounds)	103,775	175	....
Shellac (containing no cellulose or synthetic resins)	3,773,291	638	545
Other natural resins (containing no cellulose, synthetic resin, or shellac)	1,248,089	....	....
Candy glazes	63,342	....	....
Other coatings	58,350	....	....
Total lacquers, varnishes, and enamels	6,685,599	1,721,700	1,760,245
Plastics:			
Cellulose compounds	994,337	617,012	835,725
All other plastics (containing no cellulose)	1,782,613	683,219	672,601
Total plastics	2,776,950	1,300,231	1,508,326
Photographic film (including emulsions)	279,657	1,562,472	1,414,490
Transparent sheeting	30,664	534,357	539,694
Cellulose intermediates	257,450	189,283	202,893
Explosives	1,034,602	2,358,887	2,357,520
Polishes	172,993	....	....
Adhesives	79,960	....	....
Soldering flux	132,271	....	....
Ink, stains, and dye solutions (containing no cellulose or resins)	128,975	30	....
Total cellulose, resin and related products	11,579,121	7,666,960	7,783,168
Solvents and thinners for cellulose, shellac, resin products, etc.:			
Proprietary solvents	16,803,735	....	....
Other industrial thinners	994,734	5,086	....
Total solvents and thinners	17,798,469	5,086	....
Toilet preparations:			
Hair and scalp preparations	1,084,980	1,569	1,511
Shampoos	224,821	....	....
Bay rum	262,997	....	....
Face and hand lotions	629,571	....	....

Product or use	Amount used New	Reused [2] Wine gallons	Amount recovered for reuse
Body deodorants	14,995	...	...
Toilet waters	1,050,652	...	...
Perfume and perfume tinctures	198,856	...	...
Toilet soaps (including shaving cream)	40,293	...	...
Mouth washes	823,431	...	...
Tooth cleaning preparations	118,659	...	...
Total toilet preparations	4,449,255	1,569	1,511
Processing industrial, food, drug, and other products:			
Nitrocellulose (dehydration of)	2,674,180	12,896,039	12,793,575
Sodium hydrosulphite	223,505	1,645,980	1,602,422
Wood rosin and synthetic resins	371,277	5,083,480	5,088,305
Petroleum oils	288,360	3,461,708	3,466,546
Pectin	91,133	3,256,344	3,257,957
Food products other than pectin	12,943	25,985	26,476
Drug products:			
Drug extracts	137,682	593,154	615,147
Glandular products and vitamins	429,047	5,096,217	5,023,951
Medicinal chemicals	442,316	690,971	737,565
Miscellaneous	65,341	108,271	141,489
Dyes and intermediates	786,107	268,105	444,510
Perfume materials and fixatives	49,217	217,164	217,677
Photographic developers	80,199	99,327	99,404
Other chemicals	610,689	2,431,065	2,412,046
Miscellaneous	88,397	149,658	148,846
Total processing industrial, food, drug, and other products	6,350,393	36,023,468	36,075,916
Pharmaceutical products for external use:			
Rubbing alcohol	3,064,903	...	...
U. S. P. and N. F. preparations:			
Witch hazel	149,374	...	...
Liniments	87,243	...	...
Collodions	58,574	...	...
Antiseptics	17,534	...	...
Miscellaneous	136	...	...
Total U. S. P. and N. F. preparations	312,861	...	...
Tinctures of iodine	83,024	...	...
Other preparations not U. S. P. or N. F.	283,984	235	234
Total pharmaceutical products	3,744,772	235	234
Cleaning, preserving, and flavoring preparations:			
Tobacco sprays and flavors	1,774,564	...	...
Cleaning preparations	240,332	8,378	16,794
Deodorant sprays	53,042	...	...
Disinfectants, insecticides, etc.	41,060	190,304	191,415
Sterilizing and preserving solutions	43,370	...	422
Embalming fluids and related products	30,555	13	...
Industrial soaps	15,627	2,433	...
Photoengraving and rotogravure	48,935	...	...
Miscellaneous	68,606	...	...
Total cleaning, preserving, and flavoring preparations	2,316,091	201,128	208,631
Converted as a raw material in chemical manufacturing:			
Vinegar and acetic acid	7,718,558	...	...
Ethyl acetate	6,670,130	672,864	591,786
Ethyl chloride	11,957,023	128,009	...
Other ethyl esters	759,746	243,947	350,932
Dyes and intermediates	34,479	34,947	7,948
Acetaldehyde	24,572,238	16,558,493	16,577,093
Ether, ethyl	505,850	196,810	196,810
Ethers, glycol and other	899,303	7,448,804	7,449,054
Ethylene dibromide	2,140,021	197,480	197,480
Xanthates	570,598	...	...
Fulminate of mercury	152,952	17,344	17,628
Ethylene gas	1,084,573	...	...
Miscellaneous	716,103	108,227	111,999
Total converted in chemical manufacturing	57,781,574	25,606,925	25,500,730
Fluid uses:			
Anti-freeze	3,861,154	...	...
Brake fluids	61,363	...	...
Cutting oils	14,665	...	...
Other fluid uses (including door checks)	57,394	39	...
Total fluid uses	3,994,576	39	...
Fuel uses:			
Motor fuels	39,946	...	...
Other fuel uses	82,429	...	...
Total fuel uses	122,375	...	...
Laboratory and experimental uses	228,007	6,130	8,990
Grand total	[1]108,364,633	[3]69,511,540	[3]69,579,180

[1] Includes specially denatured rum.

[2] Represents amounts reused after recovery from processes where the alcohol has not become a part of the finished product. Such alcohol may have been recovered during the fiscal year 1940 or prior thereto and from any of the listed processes.

[3] Differences between these figures and totals published in "Statistics on Alcohol" for the fiscal year 1940 are accounted for by delinquent and amended reports.

WASHINGTON NEWS

(Continued from page 117)

Chemical Miscellany

Price Controls—Price ceilings have been placed by OPACS on hides of various types, carbon black, some paper products, railroad car wheels, numerous primary metals and scrap materials. In general, the effort is to fix a ceiling below the price to which goods may have advanced by the time the OPACS experts are convinced that some official control is needed. Thus far, chemical price fixing has been limited to a very small number of goods on which extreme shortages have been met and priorities apply.

Collapsible Tubes—To save tin the users of collapsible tubes for paints, adhesives, shaving preparations, and like non-food materials are being urged to use a 10 percent tin-coated alloy. This is but one of numerous shifts in container materials being vigorously pressed by O.P.M. Of course, tin saving is one of the most important of the efforts here served.

Civil Defense—The chemical aspect of civilian defense is being pressed by Director LaGuardia, first through organization at Edgewood Arsenal of special short courses to train firemen, policemen, and others in combat of incendiary, high-explosive, and poison-gas projectiles. Elaborate civilian organization is not yet being undertaken, but later it is expected that technical committees will be required for many of these subjects, both nationally and in many metropolitan areas.

Explosives Licensing—Congress is expected to enact sometime during July the explosives licensing bill which has been long pending. This will put the Bureau of Mines in charge of licenses for all persons making, marketing, or using industrial explosives or many of the raw materials from which explosives are made.

Anti-Freeze—Shortage of chemicals may hit the public most severely next fall through lack of supply of anti-freeze materials. Every one of these organic chemicals is severely restricted in distribution, partly because of new military uses and partly because of shortage of raw material for manufacture.

Sulphur and Phosphate — Coastwise shipping of sulphur and phosphate rock has been somewhat interfered with through shortage of boat space. The fertilizer industry has had to point out that unless prompt and regular movement of phosphate rock is provided, there will be no operating fertilizer plants in which to use the byproduct sulphuric acid recovered from explosives making. This argument is a very potent one in encouraging the Army to demand adequate ship space for fertilizer raw materials. The same argument functions to discourage shipwise movement of sulphur, insofar as the fertilizer industry is concerned.

Coke and Steel Boosts — It is estimated that the byproduct coke oven capacity at the end of the year will be 5 percent larger than a year before. Additional production of byproducts will be more than in proportion. Washington is working aggressively on the effort to expand tar refining, especially for recovery of the various phenolic raw materials required in plastics manufacture. Expansion of blast furnace and steel plants is also pressed, but up to the end of June this had been by voluntary action only.

Drying Oil Plans—Defense officials, users of drying oil, and the Department of Agriculture are cooperating in the effort to offset a serious prospective shortage of drying oil. The requirements of industry, both civilian and defense, can be met this year only if the stocks on hand are depleted practically to zero by the year end. That will seriously aggrevate next year's problem. Hence, sharp curtailment in consumption this year is being asked and drastic measures for crop increases and new production are being encouraged for 1942. Speed-up of research programs will, it is hoped, increase yields and possibly develop new sources of drying oil from the more abundant supplies of food oils not previously usable in the drying oil industries.

NEW YORK CHEMICAL WARFARE PROCUREMENT OFFICE MOVED

The headquarters of the New York Chemical Warfare Procurement District were moved on June 27 from the former address at 45 Broadway to 292 Madison Ave. Major Harry A. Kuhn, Chemical Warfare Service, is in charge of this District which includes New York, New Jersey, eastern Pennsylvania, Delaware, and Maryland.

READERS' VIEWS and COMMENTS

QUESTION . . .

To the Editor of Chem. & Met.:

Sir:—I read the article by F. J. Vonachen on page 138 of the May issue of *Chem. & Met.* with some interest because it involved distribution of costs between users of high and low pressure steam.

Vonachen charges only 8.5 percent of the steam cost to the steam engine in the detailed example which he gives. This implies that the user of the steam engine exhaust is charged 91.5 percent of the steam cost. Such a distribution of costs is on a "heat" basis only and makes no higher charge to the user of the 200 lb. gage steam than to the user of the 12 lb. gage steam.

It is interesting to recalculate his data using Keenan's "availability"

function, $\Delta B = \Delta H - T_0\Delta S$, as a basis for distribution of costs, where H is total heat and S is entropy. This function is a measure of the useful work theoretically obtainable from a given system which passes from one state to another in a "surroundings" at a temperature T_0. If the cost is distributed proportionally to that fraction of the total "available work" in the 200 lb. gage steam which is absorbed by the user, then we may say that the fraction F of steam cost to be carried by the steam engine is equal to ΔB (from 200 lb. gage to 12 lb. gage saturated) divided by ΔB (from 200 lb. gage to liquid water at 55 deg. F.), or

$$F = \frac{(1162-1199)-515(1.7078-1.5392)}{(23.1-1199)-515(0.0459-1.5392)} = 0.306$$

On such a basis the steam engine would bear a steam engine charge of \$316 per year as compared to \$87.70 calculated by Vonachen. Comparing yearly total costs:

	Steam Engine "heat" basis	Steam Engine "availability" basis	Electric Motor
Power	\$87.7	\$316	\$693
Other	121.9	122	69
Total	\$210	\$438	\$762

Thus the calculated yearly cost of such a steam engine is doubled if high temperature heat is considered more valuable per unit than low temperature heat.

WARD GREINER

Midland
Mich.

. . . AND ANSWER

To the Editor of Chem. & Met.:

Sir:—Mr. Greiner's letter raises a very interesting point, and the "availability" basis for distribution of costs would seem to be correct for cases where high-temperature heat actually is more valuable than low-temperature heat.

In the plant for which detailed figures are given by Mr. Vonachen, since all the engine exhaust is used for process, it would seem probable that before installation of the engine this plant was producing steam at 200 lb. gage and some portion of this steam was being throttled to 12 lb. gage for process demand. If so, the addition of the steam engine to the plant increased fuel consumption only by an amount sufficient to produce the heat taken from the steam by the engine, as the heat in the exhaust at 12 lb. gage is "available" for process requirements.

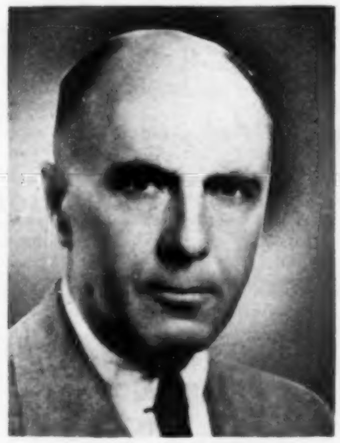
Under these conditions (which obtain in many plants), it would seem that the "heat" basis of allocating costs is correct.

A. A. PRIOR

Engineering Department
Troy Engine & Machine Co.
Troy, Pa.

PERSONALITIES

Theodore M. Switz



Harry L. Derby

✦ THEODORE M. SWITZ has been appointed director of the Export Department of Hercules Powder Co. He succeeds P. W. Meyeringh who has become vice president. Dr. Switz graduated from Lehigh University in 1922 with a degree in chemical engineering, and from the Royal College of Science, University of London in 1926 with a doctors degree. He became associated with Hercules in 1937.

✦ HARRY R. LEWIS has resigned from the Sinclair Refining Co. to form the Harry R. Lewis Co. The company will specialize in the petroleum industries in rendering three services, development of new products, assistance in marketing work, and brokerage.

✦ CHARLES B. DURGIN, group leader in the Research Department of the Phosphate Division of Monsanto Chemical Co., has been promoted to assistant director of research. He graduated from the chemical engineering department of the University of New Hampshire in 1918 and joined Swann Chemical Co. in 1922.

✦ WILMER L. KRANICH has been appointed instructor in chemical engineering at Cornell University. Mr. Kranich graduated from the University of Pennsylvania with the degree of bachelor of chemical engineering in June, 1940. He was winner of the national student problem contest of the A.I.Ch.E. in that year. During the past year he has been a McMullen graduate fellow in chemical engineering at Cornell.

✦ HARRY B. LOSE has been appointed superintendent of construction for Koppers Co., Engineering and Construction Division. He was formerly assistant superintendent.

✦ HARRY L. DERBY, president and director of the American Cyanamid and Chemical Co. has been elected a life trustee of Rutgers University. Mr. Derby is also a vice-president and director of the American Cyanamid Co., president and director of the Arizona Chemical Co., chairman of the board of the Berbice Corp., and vice president and director of the Southern Alkali Corp.

✦ WILLIAM W. COFFEEN has been appointed research associate for the Porcelain Enamel Institute at the National Bureau of Standards. He started June 16 and has until recently been instructor in ceramic engineering at the Georgia School of Technology in Atlanta. He left this position to join the staff of the Porcelain Enamel Institute. Prior to his teaching Mr. Coffeen served as research fellow at the University of Illinois Experiment Station for two years and later as ceramic engineer for the Canton Stamping & Enameling Co., Canton, Ohio.

✦ HARRY L. BAILEY, president of the Wellington Sears Co. of New York will serve as the Producers' Representative on the Textile Priority Committee. He was recently appointed by E. R. Stettinius, director of priorities.

✦ E. G. GAYLORD, Standard Oil Co. of California, San Francisco has been appointed chairman of the 1941 Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum of the American Petroleum Institute's Division of Production.

✦ W. E. GRIFFITHS and W. F. Detwiler, Jr., have been appointed manager and assistant manager respectively of the newly organized Development Engineering department of the Allegheny Ludlum Steel Corp. in Pittsburgh. The purpose of this new department is to assure full attention to the development of new processes and products for the future despite the present abnormal demands on production.

✦ E. S. BISSELL has been made vice president of the Mixing Equipment Co. Rochester, N. Y. Prior to his promotion Mr. Bissell was technical sales manager. Since joining the company in January 1937 Mr. Bissell's rise has been rapid. Within a few months he was also appointed director of research and assumed the responsibilities of development and market study. Prior to his association with Mixing Equipment Co. he was assistant to the manager of instrument sales, Bausch & Lomb Optical Co.

✦ CHARLES SAMUEL GARLAND is the new president of the Institution of Chemical Engineers. He was one of the first students of the Royal College of Science to study chemical engineering. He was a founder of the junior Imperial League and from 1922 has been president of its South London Division and in that year was the first member of the League to be elected to the House of Commons. He took a hand in the formation of the Chemical Engineering Group and The Institution of Chemical Engineers.

✦ E. K. BOLTON has been elected to receive the Chemical Industry Medal for 1941 awarded by the Society of Chemical Industry. Presentation will be made in the fall. In 1915 Dr. Bolton entered the employ of E. I. du Pont de Nemours & Co. and since 1930 has been chemical director.

✦ M. A. KING, for the past nine years manager of the turbine department of the Elliott Co., Jeannette, Pa. and previous to that chief engineer of the turbine department, has been appointed manager of engineering with responsibility for engineering, design and drafting of all products built in the three Elliott Co. plants.

✦ W. M. PAQUIN has been added to the technical sales force in the Wisconsin territory of the Quaker Chemical Products Corp., Conshohocken, Pa. Mr. Paquin is a chemist with special training in ceramic engineering and was formerly in charge of enamel control work at the Norge Div. of Borg Warner Corp., Muskegon, Mich. He will have his headquarters at Milwaukee.

✦ JOSEPH DUBOSE CLARK has been appointed chemical director of the

Glyco Products Co., Inc., Brooklyn, N. Y., where he will be in charge of research and development. Dr. Clark was graduated from Clemson College with the degree of B.S. in chemical engineering and later received his M.S. and Ph.D. in physical chemistry from Syracuse University. Dr. Clark first served as a textile consultant and with the U.S. Army Engineers, and later with the Chemical Warfare Service here in the first World War. Later he was chemical director for the State of South Carolina. Then he taught at Syracuse for seven years before engaging in industrial research and development with Firestone Tire & Rubber Co., Kalamazoo Vegetable Parchment Co., Flood & Conklin Mfg. Co., and the Nixon Nitration Works.

R. C. Wickersham

✦ R. C. Wickersham, assistant sales manager for Koppers Co., Tar and Chemical Div., has been appointed general manager of The White Tar Co. of New Jersey, Inc., a Koppers subsidiary. It was announced by J. N. Forker, vice president of Koppers Co. in charge of the Tar and Chemical Div. The White Tar Co. is to broaden its activities in the production of chemicals from coal and will increase its facilities for the merchandising of Koppers chemical products in the small-package consumer field. Mr. Wickersham joined Koppers in 1916, a year after he was graduated from Lehigh University with a degree in engineering. He was associated with the engineering, construction and operating departments until 1920 when he left to build and operate refineries in Texas and California for the extraction of casing head gasoline from natural gas. He returned to Koppers in 1923.

✦ Gregoire Gutzeit arrived in this country May 26. Dr. Gutzeit graduated with honors in chemical engineering from the University of Geneva where he also received his doctor's degree. He has been associated with the Dorr Co. since 1937, largely in connection with the European organizations

work in flotation. He is now located at the Westport Laboratory of the company.

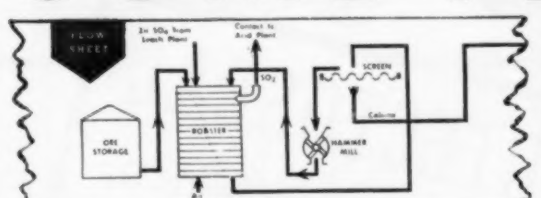
✦H. I. CRAMER, professor of rubber chemistry at the University of Akron has resigned from that position and on or about Aug. 1 will join the Research and Development Department of Sharples Chemicals, Inc., Philadelphia, formerly known as The Sharples Solvents Corp. Dr. Cramer was graduated from the University of Akron in 1926 and in 1929 he received his Ph.D. degree from the University of Wisconsin. He then served as a research chemist with Goodyear Tire & Rubber Co. until 1933, when he assumed his position at the University of Akron.

✦H. A. VAN DERCK FRECHETTE, who has held a graduate school scholarship in ceramic engineering during the past year, has received an appointment as teaching assistant at the New York State College of Ceramics, at Alfred, for the coming year. He received his M.S. from Illinois last June after spending two years as research graduate assistant in the Engineering Experiment Station.

✦A. R. RODRIQUEZ from Manila, Philippine Islands received his Ph.D. degree in ceramics from the University of Illinois this year. After spending several months visiting manufacturing plants in this country he is going back to Manila about September to start a department of ceramics at the University of the Philippines.

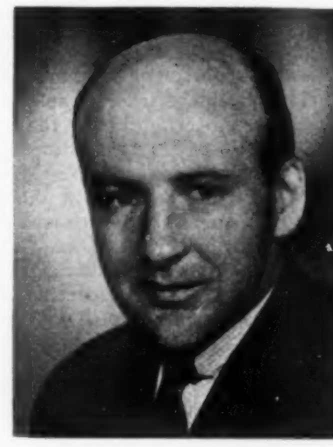
✦FRED H. RHODES, director of the School of Chemical Engineering, Cornell University is the first to hold the Herbert Fisk Johnson Professorship in Industrial Chemistry, recently established at the University. The new chair memorializes the former head of S. C. Johnson & Son, Inc., of Racine, Wis. Dr. Rhodes from 1917 to 1920 was research chemist and chemical engineer and director of research in the chemical department of the Barrett Co. He also acted as consultant for the Anaconda Copper Co., the Atlantic Tar & Chemical Co. and other industrial concerns. Since 1920 he has been professor of industrial chemistry and chemical engineering at Cornell and has directed the curriculum in chemical engineering since its establishment in 1930.

✦GEORGE R. SPAULDING, of Oradell, N. J., sanitary engineer of the Hackensack Water Co. received a George W. Fuller Memorial Award of the American Water Works Association at a dinner in Toronto, June 26. The award was made for meritorious achievement in improving water works service. The citation stated: "The most outstanding service made by him is the pioneering work done in connection with the application of activated carbon on a plant scale for taste and odor removal.



Following his experiments, the use of activated carbon gradually became an accepted method of taste reduction in water filter plants in this country."

✦ J. A. Krug, manager of power for the Tennessee Valley Authority is being loaned temporarily to the Office of Production Management to be advisor to the Materials Branch, Production Division, on power problems in connection with the expansion of aluminum and magnesium production. Mr. Krug has been associated with TVA since January, 1938.



James F. Hand

✦ C. W. Christensen, assistant general manager of sales of the Rubber Service Department of Monsanto Chemical Co. has been promoted to general manager of sales. Promotion of James F. Hand of the Rubber Service sales department to assistant general manager of sales has also been announced by G. Lee Camp, vice president. Both Christensen and Hand have headquarters at Akron, Ohio. Mr. Christensen is widely known in the rubber industry. He was born in Akron in 1899 and he obtained a degree in chemistry at Akron University. Hand was born in 1906 in Cincinnati. He was graduated from Cornell University with a degree in chemistry, working at Cornell for a year as instructor in the chemistry department. In 1928 he was employed as a chemist by the American Rolling Mill Co., at Middletown, Ohio. He then went to Akron to join the B. F. Goodrich Co. as chemist. In 1930 he was employed as a salesman by the Rubber Service Department of Monsanto.

✦ Samuel R. Fuller, Jr. is resigning as chief of the Materials Branch, Production Division of Production Management, to return to the presidency of the North American Rayon Corp. Mr. Fuller joined the defense organization on Feb. 20 as chairman of the Production Planning Board. Later he was chosen to head the Materials Branch and resigned from the chair-

manship of the Production Planning Board to carry on his duties with the Materials Branch.

✦ JOSEPH W. BARKER, dean of the School of Engineering of Columbia University has been appointed by Secretary of the Navy Frank Knox as special assistant in charge of the newly created Division for Training Liaison and Coordination in the office of the Assistant Secretary. The special assistant in charge of the division will serve as the Navy Department's representative in all cooperation with other governmental agencies for civilian vocational training and non-military education. Dr. Barker has been dean of the School of Engineering at Columbia since 1930.

✦ WILLIAM A. BRANDENBURG, JR., a Bachelor of Science graduate in Chemistry from Albright College has been added to the Research and Development Laboratories of Bakelite Corp., at Bloomfield, N. J.

✦ FRANK M. RUGG, who has received a Bachelor of Science degree in Physics from Mississippi College and a Master of Science in Physics from the Louisiana State University, and a Ph.D. in Chemistry from the University of Illinois has joined the Research and Development Laboratories of the Bakelite Corp., Bloomfield, N. J.

Clyde A. Crowley

✦ CLYDE A. CROWLEY and Harry Bennett have formed the new firm of technical consultants, Crowley and Bennett. Crowley is known for his work in electrochemistry, and Bennett as editor of the Chemical Formulary and for his work on emulsions. Headquarters will be in Chicago, and there will be an eastern branch in Brooklyn, N. Y.

✦ A. J. P. WILSON of Great Neck, N. Y., has graduated from the Army Industrial College in Washington. Major Wilson has been assigned as chief, manufacturing division, New York Chemical Warfare Procurement District.

✦ EARL P. STEVENSON, president of Arthur D. Little, Inc. and an alumnus of Wesleyan University was presented with the honorary degree of Master of Arts on June 15 at commencement exercises of the University.

✦ R. W. TRULLINGER, assistant chief of the Office of Experiment Stations, U. S. Department of Agriculture, Washington, received the John Deere Gold Medal from the American Society of Agricultural Engineers for "distinguished achievement in the application of science and art in soil," in a career of research administration.

OBITUARY

✦ EDWARD J. SMAIL, JR., general sales manager of the Rubber Service Department of Monsanto Chemical Co. died June 8 at People's Hospital in Akron, Ohio after a lengthy illness. Mr. Smail was born Dec. 22, 1888, in Braddock, Pa. He was graduated from Washington and Jefferson College in 1907 and began his business career with Firestone Tire & Rubber Co. engaging in sales work from 1913 to 1916. In 1921 with three business associates Mr. Smith founded the Rubber Service Laboratories with a plant in Nitro, W. Va. and sales offices and laboratories in Akron.

✦ LEWIS A. RICE, engineer and salesman of the Traylor Engineering & Mfg. Co., Allentown, Pa. died on June 4 at the Allentown Hospital after about a week's illness. He was in his seventy-first year. Mr. Rice had been with the Traylor Company for upwards of thirty years and was one of the company's oldest employees.

✦ GUY A. BARKER of Johns-Manville died June 18 after he suffered a heart attack at his home in Scarsdale, N. Y. He was 50 years old. Born in Palmer, Neb., Mr. Barker was reared on a farm near Boise, Idaho. He was graduated from the University of California with honors in 1914. Prior to his joining the Johns-Manville organization in 1921 he was associated with the Pacific Gas & Electric Co. in San Francisco as chief engineer for the Central Teresa Sugar Co. of Cuba, and chief mechanical engineer of the Industrial Accident Commission of California.

✦ WARREN GILMAN JONES, president of the W. A. Jones Foundry & Machine Co. of Chicago succumbed to a heart attack and passed away at his home in River Forest, Ill. He was born in Chicago in 1890 and entered his father's firm in 1910. Since 1925 he has been president. He was also vice president of the Sackett Screen & Chute Co. of Chicago. He died on June 6.

✦ HARRY C. MERRIAM died June 27. Mr. Merriam was vice president of E. B. Badger & Sons, Boston, Mass.

NEWS OF PRODUCTS AND MATERIALS

ELECTROLYTIC BLACKENER

Electrolytic blackening of almost all metals including aluminum, steel, zinc, cadmium, nickel, silver, gold, lead, tin and various alloys may be accomplished by a recently announced process called Electro-Ebonol, a product of the Enthone Co., New Haven, Conn. The process is interesting in view of the shortage of nickel salts for black nickel solution. The new deposits are said to be harder, blacker and more adherent than black nickel. The salts are supplied ready for use. A solution of 12 oz. per gal. of water is used and operated at from 140 to 190 deg. F. Current densities required are low, ranging from $\frac{1}{2}$ to 5 amp. per sq.ft. Voltage from 1 to 2 depending upon the set-up. Anodes may be of carbon or stainless steel. Tanks may be of wood, stainless steel, ceramic or Monel metal.

PLASTIC GLUE

Among the recent developments of Synvar Corp., Wilmington, Del., is a phenol plastic glue for plywood and panels of all kinds. This material is for use in the manufacture of exterior plywood as it is called, and plywood or panels made with this material have exceptional water resistance and strength, and with ability to withstand tests prescribed by the U. S. and Canadian governments for exterior plywood.

COLD-SETTING CEMENT

Urea resin for use as cold-setting adhesives is becoming increasingly popular. The Resinous Products and Chemical Co., Philadelphia, Pa., has recently announced Uformite CB-550, a new synthetic resin adhesive for plywood manufacture and wood part assembly, which gives an extremely strong waterproof and fungus resistant bond without the use of hot pressures or other special equipment. It is supplied as a dry water dispersible powder, and is simply mixed with water to paste consistency, for it contains its own catalyst which causes the resin to react or set in 6 to 8 hours in the plant at room temperature.

LUBRICANTS

Two new lines of lubricating greases for ball and roller bearings have been announced by Gulf Oil Corp., Gulf Refining Co., Pittsburgh, Pa. One designated Gulf Anti-Friction Grease, is recommended for heavy duty service; the other, Gulf Precision Grease, is recommended for lighter duty and higher speeds. Both have a high melting point and are specially prepared for greatest resistance to oxidation and separation.

CLAY

Announcement has been made of a new feature of Ferro clay used in processing porcelain enamel metal products. This is "controlled consistency" which means that the "set" or "consistency" characteristics of Ferro clay made by the Ferro Enamel Corp., Cleveland, Ohio, are now laboratory controlled and kept within very narrow limits. This offers the porcelain enameler an opportunity for the closer control of setting up procedures in the mill room and likewise the reduction of reject hazards.

WETTING AGENT

A new synthetic wetting agent and detergent which is non-electrolytic and therefore compatible with almost any type of material has been announced by Rohm & Haas Co., Philadelphia, Pa. Known as Triton NE, the new material is a high molecular weight complex organic alcohol, taking the form of a viscous, transparent, pale amber liquid. It contains no nitrogen, or sulphur and leaves no ash. It is recommended for electroplating and acid scouring. Scouring baths with and without soap, dye baths and salting out solutions, strong acid mediums where most surface active agents lose activity, hard water and sea water and any wetting or cleaning operation.

PROTECTIVE COATING

The corrosion and disintegration of metal parts exposed to gaseous atmospheres at furnace temperatures, can be prevented by the use of a recently developed material Metlseel, made by the Porcelain Enamel & Mfg. Co. of Baltimore, Md. With the increasing difficulty of obtaining heat resisting alloys and steels due to priority rulings, it is believed that Metlseel will be of interest to the heat treating industry. It is applied as a liquid coating and withstands heat in excess of 1,500 deg. F., prevents oxidation and keeps the metal parts sound and clean.

PHARMACEUTICAL

Newest of the sulpha drugs, sulphaguanidine, was recently made available to the medical profession by Lederle Laboratories, Inc., New York, N. Y. This preparation is a powerful aid to the medical profession in combatting infectious diseases. Sulphaguanidine which is made by Calco Chemical Division of American Cyanamid Co., differs from the other sulpha drugs in its action. When administered by mouth, it remains largely in the intestinal tract. Thus it is able to destroy or prevent the growth of certain bacteria in the alimentary canal.

Chem & Met MEETINGS & CONVENTIONS

A.S.T.M. Meets in Chicago

MEETING in Chicago during the latter part of June for its annual convention and exhibit, the American Society for Testing Materials discussed many problems of paramount importance to chemical engineers under the present industrial emergency. Also of timely interest was the meeting of the National Fire Protection Association in Toronto. Papers of interest to chemical engineers presented at these meetings, as well as those of other technical organizations, are abstracted and presented in the following pages.

SYNTHETIC OIL IN GERMANY

TOTAL SYNTHETIC oil and gasoline production in Germany (including coke-oven benzol available for motor fuel) was between 60,000-70,000 bbls. per day at the outbreak of the war, according to R. E. Wilson, Consultant, Petroleum Unit, Office of Production Management, before the American Association of Petroleum Geologists in Houston. About 70 percent of this was made by hydrogenation of lignite with some coal and some coal tar. Most of these plants can be operated in such a way as to make fairly good aviation gasoline, although this reduces their capacity. This aviation gasoline can be leaded up to about 90 octane.

The Fisher-Tropsch process was responsible for more than 50 percent of the remaining synthetic product. This process starts from coke and makes an inferior gasoline, but good Diesel fuel and some wax. Both wax and gas from the process can be used as the starting point for the synthesis of lubricating oils, but this is difficult and no substantial amount of capacity appears to have been installed.

Benzol obtained from coke oven tars is a much desired constituent of ordinary and aviation fuel. While alcohol was used in Germany in a small way before the war, it was already on the decline in 1938-1939 and probably is now a negligible factor as its production requires the use of foodstuffs.

While the figure of 65,000 bbls. per day was probably correct for production of synthetic substitutes at the outbreak of the war, developments since 1939 are difficult to estimate. Plants which were under construction at that time would bring total capacity (including the benzol) to around 100,000 bbls. per day, but a few more plants may have been built. The author pointed out that while these high-pressure plants with complicated piping carrying inflammable products constitute ideal bombing targets, the fact that they operate under such high pressure means that the principal parts have to be made of something like armor plate and either a lucky hit at a vulnerable spot or a direct hit by a large bomb would be necessary to cause any serious damage. The author surmised that British bombing has not kept Germany's total synthetic oil production below 70,000-80,000 bbls. per day.

STATISTICAL METHOD FOR CORROSION

STATISTICAL analysis of changes in tensile strength of various non-ferrous metals resulting from atmospheric exposure was submitted by Sub-Committee VI before the American Society for Testing Materials in Chicago last June. The tests, initiated in 1931, included rolled samples of 24 non-ferrous metals and alloys in nine exposure locations.

Work on statistical methods of analysis led to the conclusion that these were applicable in interpretation of present data in spite of the small number of specimens included in each test. It was also concluded, however, that there are certain difficulties in conducting such an analysis, and that this phase of the problem will require further study. The sub-committee is not yet ready to make a final report, but feels that publication at this time, particularly of the statistical constants, will make the available results of greater value to engineers interested in corrosion.

To analyze data statistically requires that there be available the averages and the so-called standard deviations. The arithmetic means of the tensile strength in lbs. per sq.in. and standard deviations for the initial tests, and the one-, three- and six-year atmospheric exposure tests were given. The standard deviations, σ, were calculated by using the following formula:

$$\sigma = \sqrt{\frac{\text{sum of } X^2}{n} - \left(\frac{\text{sum of } X}{n}\right)^2}$$

where X is tensile strength of the individual specimen, and n is the number of specimens in a group.

COMBUSTION PROPERTIES OF COKE

IGNITION PROPERTIES of coke, according to M. A. Mayers of Carnegie Institute of Technology, Pittsburgh, Pa., before the American Gas Association in New York last May, depend to a marked extent on the reactivity property of the material. Burning properties of coke, once ignited, are shown to be determined largely by the quantities v_1/G and ν_2/G when ν_1 is rate of reaction of $C+O_2=CO_2$ per unit volume of the bed and ν_2 is rate of reaction of $C+CO_2=2CO$ per unit volume of the bed, and G is the rate of air flow entering the fuel bed per unit area of bed. Thus the above ratios may be taken as the linear rates of reaction and their magnitudes determine to a great extent (1) the effectiveness of the bed as a gas producer and (2) the magnitude and position of the maximum temperature, thus controlling clinkering tendency and suitability for the foundry cupola.

In gas producers or generators it is desirable that ν_2/G be as large as possible for two reasons: (1) the greater this ratio, the less bed depth is required for a given gas quality, and (2) the greater the ratio ν_2/ν_1, the lower the maximum temperature will be, thus decreasing difficulties due to clinkering for a given ash fusion temperature. Furthermore, the temperature throughout the bed is decreased in proportion

CALENDAR

SEPT. 8-12,	**American Chemical Society, semi-annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.**
SEPT. 16-19,	**Technical Association of the Pulp and Paper Industry, fall meeting, Ann Arbor, Mich.**
SEPT. 17-19,	**National Petroleum Association, annual meeting, Hotel Traymore, Atlantic City, N. J.**
OCT. 1-4,	**Electrochemical Society, semi-annual meeting, Hotel Knickerbocker, Chicago, Ill.**
NOV. 3-5,	**American Institute of Chemical Engineers, Annual Meeting, Cavalier Hotel, Virginia Beach, Va.**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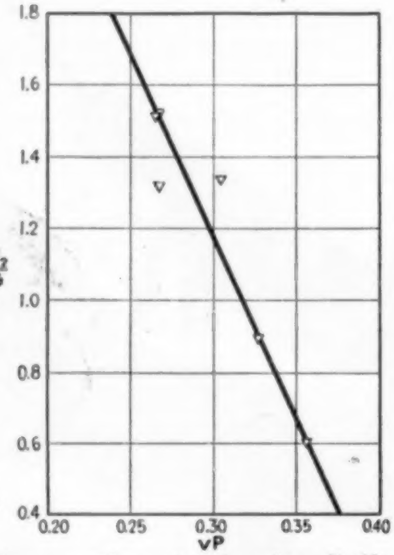
CLOSURES

as ν_1 is increased by comparison with the heat transfer coefficient between solids of the bed and gas passing through. Thus, cokes having large values of reaction rates per unit volume of bed are desirable for gas making.



Linear reaction rate of carbon dioxide (ν_1/G) as a function of void volume and porosity (*VP*) of coke

The above parameters may depend primarily on the average diameter of the coke, the void volume of the bed formed from it, and porosity of the coke. Apparently they are not closely related to the properties that are measured in tests of reactivity, at least within the limited range of reactivities of the cokes considered. Thus, ν_1/G increases with the density of packing of the coke, inversely with the size, and with increasing porosity. Increased values of ν_1/G result in an increased maximum temperature appearing at a lower level in the bed. In addition, ν_2/G increases with density of packing of the coke and with increasing apparent density for a constant true density, and inversely with the coke size. Increased values of ν_2/G result in lowered maximum temperature appearing at a lower level in the bed, and in higher concentrations of carbon monoxide and probably also hydrogen in the bed gas at a given level.

RATE OF RUSTING

INFLUENCE of environment and weight of zinc coating on the rate of development of rust on galvanized iron sheets was studied at five locations over a period of many years, reported J. B. Austin, U. S. Steel Corp. of Delaware, Kearney, N. J., before the American Society for Testing Materials in Chicago.

Data published by the Society on the average rate of development of rust on hot-dipped galvanized iron sheets exposed at Altoona, Pa., Brunot Island (Pittsburgh), Pa., Sandy Hook, N. J., and State College, Pa., can be represented satisfactorily by the following equation:

$$\log (P/100 - P) = -(a + 12.3 \log w) + 10.7 \log t$$

where P is the percentage of the surface covered with rust after t years, w is the weight of the zinc coating in oz. per sq. ft.; and a is an index which characterizes the corrosiveness of a given atmosphere for galvanized sheets as estimated by the A.S.T.M. test procedure. The value of a for different stations was given as follows:

Altoona, Pa.	4.1
Brunot Island, Pa.	5.4
Sandy Hook, N. J.	9.6
State College, Pa.	13.6

The rate curve for sheet with a given weight of coating exposed to a given atmosphere can be reduced to a straight line by the use of the autocatalytic scale as one coordinate and a logarithmic time scale as the other. A plot of this type facilitates interpolation, extrapolation and smoothing of the observations, as well as interpretation of the results. It was pointed out that the equations represent data which being the average of many measurements, should therefore be regarded as giving the life-expectancy for a group of galvanized sheets rather than as describing the appearance of rust on any individual sheet.

Comparison of Observed and Calculated Time (in Years) for Appearance of Rust on Galvanized Iron Sheets

Actual average weight of coating oz. per sq.ft.	Altoona		Brunot Island		Sandy Hook		State College	
	Observed	Calculated	Observed	Calculated	Observed	Calculated	Observed	Calculated
0.88	2.0	1.4	2.2	1.9	4.8	4.6	10.4	10.5
1.30	2.4	2.1	3.2	2.9	6.8	6.8	....	15.6
1.54	3.0	2.5	3.5	3.4	7.6	8.0	....	18.5
2.02	3.8	3.2	4.6	4.4	10.0	10.5	....	24.2
2.58	4.5	4.1	5.6	5.7	....	13.4	....	31.0

HAZARDOUS CHEMICALS

AT THE ANNUAL meeting of the National Fire Protection Association in Toronto during May, a committee report was presented which proposed to add three chemicals, benzoyl peroxide, hydrogen peroxide and zinc, to the *Table of Common Hazardous Chemicals* (4th edition 1939, as published by the N.F.P.A.). In addition, revisions were made on the following subjects: charcoal, hydrochloric acid, potassium, potassium peroxide, sodium, sodium peroxide, and magnesium and magnesium alloys.

In respect to magnesium and magnesium alloys, it was pointed out that recent tests appear to show that application of dry graphite in excess is comparatively effective in extinguishing magnesium and magnesium alloy fires, but that asbestos powder and also talc may be ineffective. In view of the use of large quantities of magnesium and magnesium alloys in the defense program, it was proposed to amend the text of the *Table of Common Hazardous Chemicals* covering fire-fighting

phases of "Magnesium" and "Magnesium Alloys" as follows:

> Delete the words "Use dry sand, talc, or asbestos powder" and "Graphite may be used but it is not as effective as sand," and substitute the wording: "Smother with an excess of dry graphite. Dry sand may be used on small fires. Not advisable to use sand around machinery."

CORROSION OF CONDENSING EQUIPMENT

WATER-SIDE corrosion of refinery condensing equipment was discussed by B. B. Morton of the International Nickel Co., Inc., New York, before the American Petroleum Institute in Tulsa, Okla. Descriptions were given of the corrosion noted with condensing equipment of cast iron, admiralty metal, copper-nickel alloys, and monel.

Cast Irons—Chief merit of cast iron is its graphitic form of corrosion, as much of the ferrite of the iron is removed from the affected zone, leaving behind a black porous structure which may retain the form of the original metal, but which is devoid of its strength. This porous material is rich in graphite and carbides and usually contains considerable free iron. The layer of graphitized material may prevent further corrosion of the cast iron. This occurs when the graphitic coating reaches some depth and the pores are clogged with insoluble matter. Under such conditions, cast iron parts may outlast steel parts for a long time.

Two methods of combatting cast iron corrosion are available through the use of alloying agents. Small additions of Ni and Ni with Cr have served to reduce corrosion rates by refining grain, reducing graphite particle size, and limiting porosity. In addition, large additions of alloys, such as used in Ni-Resist (about 15 percent Ni, 6 percent Cu, 2 per cent Cr) confer upon the alloy a high degree of corrosion resistance.

Admiralty Metal—A large tonnage of admiralty metal (70 percent Cu, 20 percent Zn, 1 percent Sn), goes into the condensing equipment of refineries. This alloy has performed in a creditable manner, and promises to hold its position for some time. This metal usually suffers from three types of attack on the water side: dezincification (general and plug types), pitting (frequently at break in deposits), and impingement attack (at inlet ends at high velocities).

Dezincification is probably the most important type of water-side corrosion of admiralty tubes in refinery service. Use of high-copper alloys, such as red brass, has been used to avoid dezincification. Attack from the oil side has generally restrained this development, but tests have shown that general dezincification can be suppressed by addition of such elements as arsenic, antimony or phosphorus, and to some extent by tin. Pitting, involving the formation of oxygen and metallic-ion-concentration cells, is a form of attack difficult to combat in the case of copper-alloy condenser tubes. Impingement attack occurs usually at the en-

trance end of tubes through which the water is being circulated at high velocities. This form of attack has not been an important factor in the destruction of tubes in refinery condensers. A suitable vent will often eliminate difficulty when the trouble is due to presence of gases released from the water.

Copper-Nickel Alloys—Copper-nickel alloys, with nickel contents of 20–30 percent, are becoming widely used in petroleum refining, with 70–30 Cu-Ni alloy apparently gaining in favor. The failure of a number of 80–20 Cu-Ni tubes indicated that attack is mostly of the impingement type. Large amount of sulphides in scale on the water side of the tube led to the belief that the protective film was impaired by sulphur. Experience has shown that the alloy with 20 percent Ni is distinctly inferior in resistance to impingement effects to the 30 percent composition.

The particular merit of the 70–30 Cu-Ni tubes are of value when: (1) dezincification is the primary cause of failure; (2) impingement attack is a prominent factor; (3) fairly wide variations in water composition and temperatures place unusual demands upon the condenser-tube material. A life of 2.5–6 times that obtained from admiralty tube often is obtained from the copper-nickel tubes, but as use of these tubes in refineries is fairly new, some time must elapse before their usefulness is truly defined.

Monel—The behavior of monel tubes (67 percent Ni, 30 percent Cu), has been marked by some premature failures, one of which was associated with locked-up stresses in the tube walls. One installation on the Gulf Coast failed after about two years, mainly from attack on the oil side, although considerable pitting occurred on the water side. An interesting feature of the copper-nickel and nickel-copper alloys is the region in the copper contents that permits growth of sea organisms. This occurs when there is 0–40 percent Cu, but from 40–100 percent, there tends to be no growth, probably because of the presence of copper in the corrosion products. This may be of interest in connection with submerged-unit condensers that appear to be increasing in popularity. Case histories of monel bundles are limited, and due to the cost ratio of monel to admiralty (about 4–5 to 1) no general use of this alloy is likely.

SYNTHETIC RUBBERS

SYNTHETIC RUBBERS, according to J. W. Schade of the B. F. Goodrich Co., before the Institute of Aeronautical Sciences at Columbia University, can be divided into five types: (1) polymers of chloroprene (neoprenes); (2) reaction products of aliphatic dihalides with alkali polysulphides (Thiokols); (3) co-polymers of butadiene with other polymerizable compounds (Perbunan, Buna S, Ameripols, Hycars, Chemigum); (4) plasticized polymers of vinyl chloride (Koroseal); (5) polymers of isobutylene (Vistanex).

Compositions of these synthetics offer no marked advantage over those of natural rubber in mechanical properties, but are far superior in resisting certain deteriorating influences often encountered in service. The earliest applications of synthetic rubbers were based on their outstanding resistance to sunlight, gasoline and oils. Occasionally only one material is satisfactory for a particular service. More often the desired results may be obtained from two or more materials. However, the synthetic rubbers are as a rule superior to natural rubber in (1) resistance to swelling and deterioration in contact with oils, organic

Comparative Properties of Rubbers[1]

	Rubber	Neoprene	Thiokol	Koroseal	Perbunan	Oil-Resistant Ameripol
Abrasion and tear resistance	E	G	P	F[2]	E	E
Adhesion to metals	E	E	F	F	E	E
Aging in storage	E	E	E	E	E	E
Chemical resistance:						
Oxidizing solutions	P	P	P	E	P	P
Ozone	P	E	E	E	F	F
Salts, alkalies, acids	G	G	G	G	G	G
Color range	E	G	P	E	F	G
Resistance to gas diffusion	F	G	E	E	G	G
Elasticity and rebound	E	G	P	F	G	F
Electrical properties:						
Conductivity	F	F	F	F	F	F
Resistance to corona cracking	P	E	E	E	P	P
Dielectric strength	E	F	F	E	F	F
Flame resistance	P	G	P	E	P	P
Resistance to flex-cracking	G	G	F	E	G	G
Resistance to flow:						
Cold	E	G	P	F	E	E
Hot	E	F	P	P	E	E
Hardness — Durometer A	20–100	10–90	20–80	10–100	10–100	10–100
Freedom from odor	G	F	P	E	F	F
Resistance to swelling:						
Chlorinated or aromatic solvents	P	P	P	Shrinks	P	F
Lacquer solvents	P	P	G	Shrinks	P	F
Mineral oil or gasoline	P	G	E	Shrinks	G-E	E
Water	F	G	..	E	E	E
Resistance to deterioration by mineral oil	P	E	F	G	E	E
Sp. Gr. of basic material	0.93	1.25	1.35	....	0.98	1.00
Range of stretchability	E	G	F	F	G	G
Resistance to checking in sunlight	F	E	E	E	F	G
Stability of properties with temp. changes:						
Cold	E	F	E	F	G	G
Heat	G	E	P	P	E	E

[1] E—excellent; G—good; F—fair; P—poor.
[2] If heat is not generated.

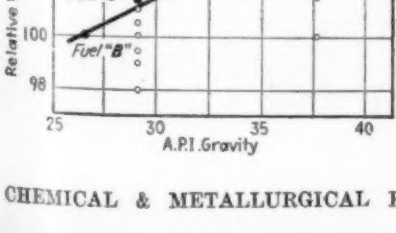
solvents and water; (2) resistance to cracking in sunlight; (3) resistance to deterioration by heat; (4) resistance to powerful oxidizing agents; (5) resistance to diffusion of gases. Natural rubber, however, still exhibits superiority to all of the synthetics now available in the following properties: (1) elasticity and rebound; (2) low heat generation through hysteresis; (3) extensibility; (4) resistance to stiffening at low temperatures.

EVALUATION OF DIESEL FUELS

THE REPORT of the Cooperative Fuel Research Committee on evaluation of diesel fuels in full-scale engines was presented before the American Petroleum Institute last May by W. G. Ainsley of Sinclair Refining Co., East Chicago, Ind. The purpose of the investigation was to determine the influence of fuel properties, such as cetane number, viscosity, volatility, and gravity on the engine performance. As a result of these extended tests, the following conclusions were drawn: (1) the ignition quality of the fuel (cetane number, A.S.T.M.) affects starting, engine smoothness, exhaust smoke, exhaust odor and combustion-chamber deposits; (2) volatility of the fuel (A.S.T.M. distillation) affects smoke and engine deposits; (3) viscosity (Saybolt Universal seconds) affects smoothness and smoke. The importance of viscosity was recognized in the basic research program as involving the consideration of ease of circulation, atomization, penetration, injection pump-plunger leakage, lubrication quality, heat content, volatility and over-all power output. The data on power output show a decrease in power with a decrease in viscosity, which may be caused in part by the effect of viscosity; (4) gravity (A.P.I.) affects smoke, power, and fuel consumption; (5) carbon residue on 10 percent bottoms (A.S.T.M.) affects smoke and combustion-chamber deposits.

It was stated that the limited number of fuels used in this series of tests makes it impossible to isolate all fuel properties and their effect on fuel performance, but that the results obtained will guide future investigations.

Diesel fuel consumption versus gravity



SELECTIONS FROM FOREIGN LITERATURE

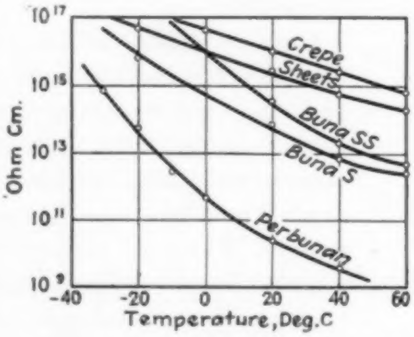
REFINING CRUDE HEAVYSPAR

Refining of crude heavyspar depends on whether it is to be used in metallurgy, for reduction to barium sulphide for chemical uses, in pigments and extenders, or in drilling muds. The usual impurities are quartz, fluorite, alumina and colored metal oxides. In the main, these are slagged along with the heavyspar in metallurgical operations and so the crude ore needs little or no refining. For drilling muds the specific gravity must be above 4.1 and some refining is needed because the common impurities tend to lower rather than to raise the density of the ore. For chemical reduction and for use in pigments and extenders the impurities are objectionable, especially fluorite and quartz. The familiar flotation method of purification wastes the potentially valuable fluorite. To purify crude heavyspar with fluorite recovery as one object a system has been developed in which hydrofluoric acid, alumina (in the form of ball mill dust) and sodium chloride are used to treat heavyspar in such a way that the fluorite is converted to cryolite. The ball mill dust used as the source of alumina contains some sodium chloride; the rest is added as needed. Quartz is removed from the heavyspar as fluosilicic acid. Crude heavyspars with different amounts of impurities are blended to obtain the most favorable composition for refining by the new method, which yields refined heavyspar and cryolite as the main products.

Digest from "Chemical Basis for Profitable Refinement of Heavyspar Containing Fluorite and Quartz," by Friedrich Vogel, *Chemische Fabrik* 14, 71, 1941. (Published in Germany.)

SYNTHETIC RUBBER IN MACHINE DESIGN

Sodium-polymerized butadiene rubbers offer the only synthetic products which fully equal natural rubber in elasticity. The grades known as "Buna S" and



Specific resistance of raw natural and synthetic rubbers as a function of temperature

"Perbunan" are outstanding examples, with the added advantages of good aging behavior, thermal stability and high abrasion resistance. Buna S is made for tires and Perbunan for goods which must be exposed to organic solvents without swelling, but each has a variety of mechanical uses. Rubber springs are replacing steel springs more and more in designs made possible by firm attachment of the Buna rubbers to metal. Perbunan is used in vibration-damping bases for machinery and in elastic couplings. Because of its resistance to oil, Perbunan is useful in printing press rolls, rotors for oil pumps, V-belts, textile machine rolls and the like. There are also a number of important electrical uses for Buna rubbers, for example, in cable insulation and in resistance units having a conducting material compounded with the rubber. Buna hard rubbers offer high resistance to chemicals when applied as linings in tanks, pipe, reaction vessels and the like.

Digest from "Buna as a Structural Material in Machinery," by H. Roelig, *Chemische Fabrik* 14, 91, 1941. (Published in Germany.)

EFFICIENCY OF DETERGENTS

Efficiency of detergents in scouring wool and washing textiles depends to some extent on the pH of the medium. Tests of potency, in terms of the ability to remove olive oil from wool, showed that increasing pH has only a slight effect on the sulphated alcohol type of detergents, whereas soaps are sensitive to increasing pH. An exception is Igepon T, the only detergent in these tests having the group $-CO.NMe.CH_2CH_2SO_3Na$. Its detergency decreases with increasing pH, perhaps because the adsorption of Igepon T depends on the zeta potential of the wool. All the tests were complicated by the salt effect, for which due allowance must be made. The pH sensitivity of soaps and relative insensitivity of sulphated alcohols are illustrated in the table, in which sodium oleate is compared with "detergent B." Detergence (G) is expressed in terms of percent removal of olive oil.

Solution	Addition	pH	G
0.1% detergent B.....	None.........	6.1	75
0.1% detergent B.....	0.05% Na_2CO_3.	10.8	66
0.1% detergent B.....	0.1% Na_2CO_3..	10.8	51
0.1% Na oleate.......	None.........	10.3	80
0.1% Na oleate.......	0.05% Na_2CO_3.	10.9	5
0.1% Na oleate.......	0.1% Na_2CO_3..	11.0	4

Digest from "Effect of pH on Detergence," by R. C. Palmer, *Journal of the Society of Chemical Industry* **60**, 60, 1941. (Published in England.)

X-RAY DEFECT DETECTORS

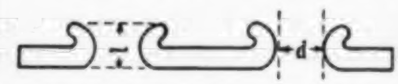
In x-ray examination of industrial and structural materials, the viewing screen is limited, by its relatively low sensitivity, to thin materials or to substances composed of the smaller, simpler atoms. It is especially useful for detecting pores, cracks, inclusions and other defects in light metal castings. The higher sensitivity of x-ray film permits its use for examining thicker steel articles. Intensifier foils which screen out visible and ultraviolet light greatly increase film sensitivity, so that steel up to 4.5

inches thick can be examined with commercial (300 kV) x-ray tubes. The intensifier foil cuts down sharpness of definition, but this is offset by the fact that high sensitivity permits use of lower tube voltages. The versatility of x-ray examination has been considerably increased by the counter tube, introduced for purposes not served by screen or film examination. The counter is especially effective for locating large defects in structural materials and for such tests as the running measurement of wall thickness. Corrosion in pipelines, gas cylinders and tanks can also be located by the counter method.

Digest from "X-Ray Examination of Materials," by A. Trost, *Zeitschrift für Elektrochemie* **46**, 508, 1940. (Published in Germany.)

METAL SOUND ABSORBERS

A MAJOR problem in the design of sound absorption systems is maintenance of absorption efficiency over a wide range of frequencies. Tests with absorbers built up from thin metal foils, finely perforated with a needle punch, show that the active resistance of such frictional layers is practically independent of frequency if the diameter of the perforations is below 0.3 mm. Similar



tests with layers of wire mesh show that the resistance is equivalent to that of foils with round perforations equal in area to the rectangular openings in the wire mesh. Resistances of layers with different densities have been measured over the entire range from 0.1 mechanical ohm per sq. cm. up to 80 mech. ohms per sq. cm. in the frequency range from 100 to 2,500 cycles per second. The observed and calculated values were in good agreement. In making the calculations for perforated foil, however, allowance must be made for the curved edges of holes, as indicated in the drawing. Micrometer measurements show that the length of the holes is about 0.2 mm. when aluminum foil 0.1 mm. thick is perforated with a needle punch. Batiste, satin and silk fabric absorbers depend more on the frequency than do metal foil absorbers, due mainly to co-vibration of the fabric layer as sound passes through it.

Digest from "Investigation of the Resistance of Frictional Layers in Sound-Absorbing Systems," by S. N. Rschevkin and S. T. Terossipjantz, *Journal of Physics (USSR)* 4, 45–56, 1941. (Published in Russia.)

SYNTHETIC RUBBER IN MACHINERY

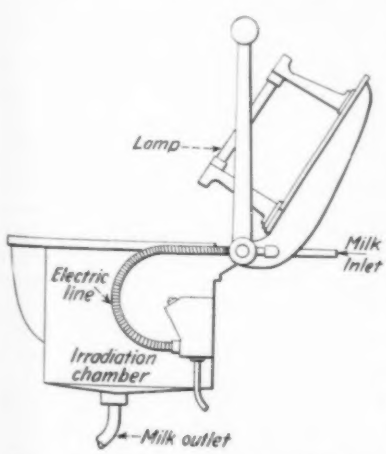
SYNTHETIC rubber of the "Buna" (sodium-polymerized butadiene) type has numerous uses in construction of machinery. Because of its elasticity it is useful in buffers and shock absorbers. It serves for oscillation dampers and sound absorbers in aircraft and is competing with steel in many types of springs. In the operation of oscillation dampers the effect is greater the higher

the frequency of the vibrating force in comparison to the resonance frequency of the buffer system, and due attention must be given to this factor. Perbunan, a semiconducting synthetic rubber, is particularly useful for preventing accumulation of static electricity in belts, gasoline hose and other products subject to conditions which tend to build up static charges. Hard Buna rubber has excellent resistance to chemicals when used in linings for tanks, pipe and fittings. It is equal to hard rubber products from natural rubber in chemical and mechanical durability and superior in heat resistance. Hard rubber filter plates and certain hard rubber parts for rayon machinery are successfully made of Buna rubber. For jacketing electric cables Buna rubber shows better aging behavior than natural rubber, and greater heat resistance. Specific electric resistance is compared with that of some other raw rubbers in the chart. (Page 140.)

Digest from "Buna as a Material In Machine Construction," by H. Roelig, *Chemische Fabrik* **14**, 91, 1941. (Published in Germany.)

ENGINEERING ASPECTS OF MILK IRRADIATION

PRINCIPAL difficulties encountered in fortifying milk with vitamin D by irradiation with UV light arise from the sensitivity of milk to oxidation, especially under the accelerating influences of heat, light, traces of catalytically active metals and ozone from the irradiation. Aeration is of utmost importance because it is essential for



Device for irradiation of milk using ultraviolet light

cooling and for sweeping out ozone, but it must be limited to the necessary minimum. Exact temperature control is also essential.

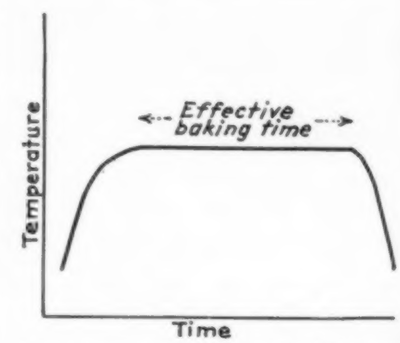
An improved irradiator is described and illustrated in which the mercury vapor lamp is carried in the cover of the irradiation chamber. The lamp is automatically turned on when the lid closes and off when the lid opens. Milk is fed to the chamber through stainless steel (V2A) pipes and flows in a film down the chamber wall. Film thickness is from 0.2 to 0.5 mm. and exposure time is about 0.5 sec. Air sup-

ply is controlled with the aid of a flowmeter and a volume meter, allowing about 2 cu. m. per minute for ozone removal and prevention of localized overheating within the irradiation chamber. A battery of 12 irradiators will treat about 1,580 gallons of milk per hour, using about 14 kw. of current per 1,000 gallons.

Digest from "Present Technical Status of Milk Irradiation," by W. Diemair, *Chemische Fabrik* 14, 51, 1941. (Published in Germany.)

LACQUERED FOOD TINS

TINPLATE can be effectively lacquered on a roller coating machine but the lacquer film is fractured (often along with the tin coating) in forming the can body, and again in the stamping operation. Some of the vinyl resin lacquers are flexible and tough enough to withstand stamping. A method known as flush lacquering has been success-



Time-temperature curve for baking can lacquers

fully adapted to large scale operation. In this method lacquer is poured into the can and drained out while the can is revolving, under closely calculated conditions of viscosity, drainage time and angle so that the entire inner surface is uniformly coated. The film is then baked, preferably not above about 330 deg. F. since can solder melts at about 350 deg. F. Tests show longer storage life for foods packed in flush-lacquered cans than for those in standard cans. Baking the film is an important feature of the process. In a well constructed oven the films will actually be at the specified baking temperature for about 13 minutes in a 20-minute bake. This is illustrated by the time-temperature curve in the diagram, showing about 5 minutes used up in reaching oven heat and 2 minutes in cooling before actually leaving the oven.

Digest from "Containers and Lacquers for Foodstuffs," by F. D. Farrow and T. G. Green, *Chemistry and Industry* 60, 95, 1941. (Published in England.)

EXTRACTING AROMATICS FROM PETROLEUM

ANHYDROUS methanol can be used to extract aromatic hydrocarbons from the gasoline and kerosene fractions of a crude oil from the Syukkoko field in Formosan. The specific gravity relations are such that a relatively small

volume of solvent is preferable for selective extraction of the aromatic components and the phase separation is different for light and heavy fractions. That is, in extracting gasoline with methanol the aromatics appear in the upper layer of liquid whereas in extracting kerosene the aromatics appear in the lower layer. The miscibility temperatures were determined as an aid to selecting the best extraction conditions. These temperatures are:

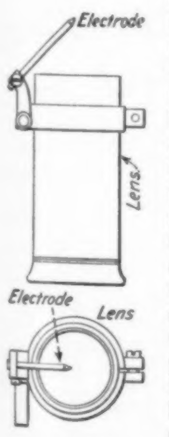
Wt.—percent methanol	Gasoline	Kerosene
10	Miscible	Immiscible
20	2.5 deg. C.	Immiscible
30	4.7 deg. C.	Immiscible
40	8.2 deg. C.	Immiscible
50	8.0 deg. C.	Immiscible
60	3.8 deg. C.	Immiscible
70	Miscible	Immiscible
80	Miscible	Immiscible
90	Miscible	35.0 deg. C.

For extracting gasoline the temperature must therefore be kept below 10 deg. C. The gasoline fraction used in these tests contained 54.9 percent aromatics while the kerosene fraction contained somewhat more.

Digest from "Selective Extraction of Aromatics From Lighter Fractions of Syukkoko Oil With Anhydrous Methanol," by *Sinzi* Syono, *Journal of the Society of Chemical Industry, (Japan)* 44, 18B, 1941. (Published in Japan.)

SPECTROSCOPIC EXAMINATION OF METAL INCLUSIONS

A NEW device for ascertaining the nature of inclusions in metals is arranged for photographing a spark spectrum of the inclusion. A thin mica flake is perforated with a microdrill and laid over the inclusion, which is then sparked in a spectrograph. The elements in the inclusion are identified by their lines in the spectrogram. A light ray from a mercury vapor lamp is focused to pass through the hole (only a few hundredths of a millimeter wide) in the mica flake. The sample is then viewed through a lens fitted with an auxiliary electrode (see drawing) and the auxiliary electrode is accurately placed so that when it is connected to the high voltage current a spark passes to the hole in the mica, on which the light ray is also focused. To prevent the spark from damaging the perforation in the mica flake a liquid resistance of about 50,000 ohms is introduced into the high voltage circuit, and the capacity which is parallel to the spark path is cut down to 400 cm. It is then unnecessary to introduce a self induction. By this means the chemical composition of some extremely small inclusions in metals has been definitely established.



Digest from "Spectroscopic Examination of Small Surface Elements," by G. Thanheiser and J. Heyes, *Chemische Fabrik* 14, 75, 1941. (Published in Germany.)

New Titles, Editions and Authors

Chem & Met BOOKSHELF

RESEARCH DIRECTORY

INDUSTRIAL RESEARCH LABORATORIES OF THE UNITED STATES, including consulting research laboratories. Seventh Edition. Compiled by *Callie Hull* for National Research Council. Published by the National Research Council, Washington, D. C. 372 pages. Price $3.50.

THIS brings up to the end of 1940 the list of 2,254 industrial research laboratories which have been surveyed by the National Research Council. It includes every type of industrial laboratory doing scientific research and a few institutions of quasi-official nature. The National Bureau of Standards is the only Government laboratory listed. It is included because it "cooperates so closely with industry." Laboratories of educational institutions are included only when directly supported by industry rather than by the institution.

Inclusion of the names of senior personnel of the research laboratories makes this volume an extremely valuable directory of individual investigators, as well as an unequalled work of reference to companies' activities in the scientific field. Splendid indexes are included, giving summaries by geographic location and alphabetic listing of individuals. The subject index of research activities also is very complete, facilitating quick identification of institutions doing important work on each of many hundreds of indexed subjects.

No industrial executive interested in research or chemical engineer working in this field can afford to be without convenient access to this volume.

CHEMICAL DICTIONARY. Compiled by *F. H. Campbell*. Published by Tait Publishing Co., Melbourne, Australia. 83 pages. Price 5s. 6d.

HANDY in size, this little booklet contains approximately one thousand of the terms used by chemists and which are so often totally unintelligible to the layman. The definitions appear to be accurate and up-to-date. No definitions or descriptions of chemicals, elements, metals or alloys are included.

EXPLOSIVES

THE CHEMISTRY OF POWDER AND EXPLOSIVES. Volume I. By *Tenney L. Davis*. Published by John Wiley & Sons, New York, N. Y. 216 pages. Price $2.75.

FOUR chapters of what was originally intended as a nine-chapter book are included in this volume. They are: Properties of Explosives, Black Powder, Pyrotechnics, and Aromatic Nitro Compounds. The second volume will discuss smokeless powder, nitric esters, dynamite, detonators and other military and non-military explosives. The sequence of the chapters might be considered illogical and the decision to publish two volumes may seem strange. Both, however, are the result of an immediate need for a textbook. As the author points out, many young chemists not previously experienced with explosives will soon be working with them. Therefore, it seemed wise to present as much as possible of what was to be a textbook, "primarily for chemists, already well trained, covering both the chemical and physical phenomena which explosive substances exhibit." So what had been written as chapters I, II, III and IX became the first four chapters of volume one.

Chapter I consists mainly of background material—definitions, classifications, detonation velocities and tests of explosive power and brisance. In the second chapter, the history, uses and manufacture of black powder are described. The third chapter, devoted entirely to civilian fireworks, also contains much historical information as well as descriptions of modern manufacturing methods and numerous recipes.

From the standpoint of chemical engineering, Chapter IV is most important, doubly so because of our present defense activities. In it will be found introductory paragraphs giving general uses, descriptions, and a background discussion of organic chemistry. The sections devoted to individual compounds give a few historical notes, equations and directions for preparation as well as melting points, solubilities and modes of chemical and physical behavior. Photomicrographs and tables of properties, solubilities and comparative tests are used to amplify the material of the text. The chapter is important as an authoritative reference on a subject of increasing national importance. It will be widely used both as a textbook and as a handy reference manual.

It is to be hoped that the forthcoming second volume of Prof. Davis' book will be up to the high standard set by the first.

FERTILIZER NEEDS

HUNGER SIGNS IN CROPS. A symposium prepared by fifteen experts in agronomy and published by American Society of Agronomy in cooperation with National Fertilizer Association. Distributed by National Fertilizer Association, Investment Building, Washington, D. C. 327 pages. Price $2.50.

Reviewed by *R. S. McBride*

THIS is a handsomely illustrated volume showing the ways in which fertilizer needs for various crops may be identified. The colored plates show in splendid detail exactly the way in which deficiencies in plant food are exhibited by the symptoms of the under-nourished crop.

The book has its maximum value for agronomists, agricultural workers, and those engaged in various phases of plant nutrition. However, the scientific men of the fertilizer industry will find it a very valuable reference volume, and the sales divisions of that industry an invaluable aid in dealing with both practical agricultural groups and with their scientific confreres.

HIGH PRESSURE TECHNIQUE

THE DESIGN OF HIGH PRESSURE PLANT AND THE PROPERTIES OF FLUIDS AT HIGH PRESSURES. By *Dudley M. Newitt*. Published by Oxford University Press, New York, N. Y. 491 pages. Price $10.

Reviewed by *Norman W. Krase*

FOR those interested in the application of high pressures in research and in industry, the appearance of this book will recall Harold Tongue's "Design and Construction of High Pressure Chemical Plant" which was reviewed in *Chem. & Met.* July, 1934, p. 374. The earlier book concerned itself primarily with equipment and design features important at elevated pressures and drew heavily on the Teddington Laboratory experience. The present book does not neglect such subjects, devoting about 100 pages to materials of construction, analysis of stresses in cylinder walls under pressure, measurement of pressure, and the design of small and semi-scale experimental equipment. The principal contribution, in the reviewer's opinion, that this book makes is in the field of physical chemistry and thermodynamics. The contribution is perhaps largely in compiling and interpreting the available data on the properties of fluids as modified by pressure. PVT relations of gases and liquids are summarized and the use of the more important equations of state illustrated. An excellent discussion of the effect of pressure on viscosity, solubility, refractive index and vapor-pressure covers the information available in scattered literature sources. Of special interest and importance are the treatment of vapor-liquid equilibria in binary and ternary systems and the related subject of gas liquefaction. This brief mention of topics is only a high-spot, incomplete list of the subject matter covered but should show that Professor Newitt's book is likely to become a comprehensive reference text for workers in the high pressure field.

An outstanding feature of the book is the author's approach to interpretation and correlation of physical and thermodynamic properties of fluids as modified by pressure. Wherever possible he starts with the kinetic theory and the fundamental thermodynamic relations, developing empirical modifications as necessary. For this reason the book will be interesting to the student and scientist as well as the practical man in industry. Professor Newitt has lavishly reproduced detailed drawings of apparatus used by previous workers together with excerpts from their papers with the thought that experimental results can best be interpreted and understood with a full knowledge of experimental limitations. The book is a valuable contribution to the literature in its field.

FLUORESCENCE

FLUORESCENT LIGHT AND ITS APPLICATIONS. By *H. C. Dake* and *Jack De Ment*. Published by Chemical Publishing Co., Brooklyn, N. Y. 256 pages. Price $3.

Reviewed by *J. R. Callaham*

PRIMARILY mineralogical in viewpoint, this book gives considerable attention to descriptive matter on fluorescent minerals, luminescence of gems and a discussion of museum and private collections of fluorescent minerals. Other chapters deal briefly with the theory and types of luminescence, sources of ultra-violet radiations, historical aspects, and uses in various fields. Fifteen pages are devoted to a discussion on fluorescent light as applied to chemistry, principally fluorescence analysis. This material is abbreviated and general in nature.

A serious defect in the book is the inadequacy and incompleteness of both subject and author indexes. For instance, in the 15-page chapter devoted to applications of fluorescent light in chemistry, this reviewer counted a total of 40 author references. These included 4 cases in which the authors were indexed but not on the correct page and 14 cases in which the author was not indexed at all. The subject index is equally incomplete. There evidently is no rule governing indexing of chemical words, since some are included while others equally as important are not indexed at all. This fault renders the book practically useless as a serious reference.

Although the authors have extensive literature references throughout the text, these are made in such a manner that the reader desiring further information is practically helpless. True, a bibliography is included under which references are listed broadly into certain major divisions. The authors seem to be listed haphazardly, neither alphabetically, chronologically nor by any other system, and as only the journal title is given and no reference to the text is included, this material gives no idea as to the contents of the articles.

This reviewer was somewhat con-

fused to find a scant two-page discussion of fluorescent lighting, certainly an important development, included in a 5½-page section on Criminology, and a section on theatrical applications almost indistinguishable from the section on pharmaceuticals.

In spite of these faults, the book remains of interest to mineralogists and the layman who desires a broad and elemental discussion of the subject.

COMPANY HISTORIES

DYES MADE IN AMERICA, 1915–1940. By *William Haynes.* Published by Calco Chemical Div., American Cyanamid Co., Bound Brook, N. J. 60 pages.

CHROMIUM CHEMICALS, THEIR DISCOVERY, DEVELOPMENT AND USE. Published by Mutual Chemical Co. of America, New York, N. Y. 36 pages.

SALT OF THE EARTH. *By Arthur Pound.* Published by the Atlantic Monthly Co., Boston, Mass. 122 pages.

"CHEMICAL INDUSTRY is its own best historian." This statement is verified by three recent publications, one on the development of the American dye industry, one on the historical background of chromium chemicals and one on the growth of an alkali company.

The first booklet, impressively illustrated in color as well as in black-and-white photographs and sketches, gives us the dramatic story of the development of the American dye industry from 1915 to the present. Included are interesting facts on the shortage of dyes caused by the World War and the sky-rocketing of prices that reached such maximums as $4 per lb. for salicylic acid and $5 per gallon for toluol. Those were the days when asperin sold for $5.60 per pound (40¢ per pound in Europe) and headaches were as frequent as they were expensive. Particularly interesting is the story of the Cott-a-lap Company of Somerville, N. J., which in 1915 quietly began a dye industry by the aid of one chemist, an assistant, a professor of organic chemistry as consultant and sets of Schultz's *Farbstofftabellen* and Friedländer's *Fortschritte der Teerfarbenfabrikation* as well as a well-used copy of Bucherer's textbook of dyestuff chemistry. This was the origin of the Calco Chemical Co., which now pays over $6,000,000 a year for raw materials, consumes some 12,000 tons of metallic iron as a reducing agent alone, and has more than 500 chemicals on its list. The story of this development from aniline by cook-book methods in 1915 to 7,500 pounds per day of tetranitroaniline in 1917 and finally through highly organized research to the recent sulfanilamides and sulfapyridines, has been presented in a manner that will stir the imagination of every chemically-minded individual.

From the time when crystals of red crocoite mineral sold for their weight in gold to the isolation of the element chromium in 1797 by Vauquelin, then to the famous Kurtz chrome colors of London and the founding of the Amer-

ican chromium chemical industry by resourceful Isaac Tyson in 1827, through periods of development that have touched practically every major industry, and finally down to the present war emergency, the history of chromium chemicals and their uses has been told in a manner both interesting and instructive. The booklet is well illustrated by numerous sketches.

Subtitled "The Story of Captain J. B. Ford and Michigan Alkali Company," Mr. Pound's book is a history of a remarkable man and one of the companies he started. At the age of 69 Captain Ford was penniless. The fact that more than 10 years later the Michigan Alkali Co. was started by this same man is indicative of the energy and resourcefulness which made him, at the time of his death, reportedly worth ten million dollars. His numerous and varied enterprises offer us not only a life history of the man but also serve as an interesting commentary on people and events of the nineteenth century. That portion of the book dealing with the Michigan Alkali Co. describes its early years, growth, its process and quarry, and mines. Both stories are well and interestingly told.

LA CULTURE DU SOJA. By *Am. Matagrin.* Published by the author, Chindrieux (Savoie), France. 126 pages. Price 25 francs.

As THE title implies, this book deals principally with the growing of soybeans. There is, however, in the concluding chapter discussion of agricultural, food, medicinal, and industrial uses. Emphasis is placed on the soybean oil, lecithin, and casein as the principal industrial products. Only three pages are devoted to "industrial" uses compared with ten pages devoted to discussion of food uses.

A number of illustrations are found in the book showing the soybean during the course of cultivation. The Continental viewpoint, of course, predominates on all phases of the subject. Economics, climate, soil, and harvest are all described from the viewpoint of one who is raising soybeans for the European markets.

HEALTH HAZARDS OF OCCUPATIONAL ENVIRONMENTS. Educational Health Circular No. 154. By *M. H. Kronenberg* and *K. Morse,* Illinois Department of Public Health, Springfield, Ill. 46 pages. Gratis.

INTO this booklet has been packed a wealth of information which summarizes most of the present-day knowledge of industrial health hazards. Sanitation, ventilation, illumination, and fatigue are covered in the introductory sections. Dusts, dermatitis, solvents, gases, and heavy metal poisoning sections are of particular interest in the chemical industries. Discussions are brief but complete, much of the information being appended in outline form to the paragraphs which cover a specific subject.

While the booklet does not purport to cover the subject in its entirety, it will and should be eminently successful as "A Guide for Industry, Labor, the Medical Profession and Public Health Personnel."

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Defense—One Year. Office for Emergency Management, unnumbered pamphlet; 10 cents.

Storage and Shipment of Dangerous Chemicals. War Department, Technical Manual 3-250; 20 cents.

Supply and Field Service. Chemical Warfare Service Field Manual 3-15; 20 cents.

Engineer Soldiers' Handbook. War Department, Basic Field Manual 21-105; 20 cents.

Water Transportation. War Department, Technical Manual 10-380; 15 cents.

Research—A National Resource, Part II, Industrial Research. National Resources Planning Board unnumbered document; $1.00.

Compilation of the Social Security Laws, Including the Social Security Act, as Amended and Related Enactments Through the 76th Congress. Social Security Board, unnumbered document; 10 cents.

Preliminary Report on Synthetic Organic Chemicals, United States Production and Sales, 1940. U. S. Tariff Commission, unnumbered document; mimeographed.

Quotas on Imports of Wheat and Wheat Flour. U. S. Tariff Commission, unnumbered document; mimeographed.

Cumulative Supplement to Changes in Import Duties Since the Passage of the Tariff Act of 1930. U. S. Tariff Commission, unnumbered pamphlet; mimeographed.

Compilation of Laws Relating to Mediation, Conciliation, and Arbitration Between Employers and Employees, Laws Disputes Between Carriers and Employers and Subordinate Officials Under Labor Board, Eight-Hour Laws, Employers' Liability Laws, Labor and Child Labor Laws. Compiled by Elmer A. Lewis, Superintendent, House Document Room; 40 cents.

List of Occupations Approved by the Office of Production Management for Vocational Training Courses for Defense Workers. Office of Production Management, unnumbered document.

Earnings and Hours in the Leather and Leather Belting and Packing Industries, 1939. Bureau of Labor Statistics, Bulletin 679.

Growth of Plastics Revealed by United States Census Statistics. Bureau of the Census, unnumbered mimeographed release, May 6, 1941.

1940-1941 Annual Naval Stores Report on Production, Distribution, Consumption and Stocks of Turpentine and Rosin of the United States, by Crop Years. Bureau of Agricultural Chemistry and Engineering, ACE-92; mimeographed.

Statistics on the Uses of Specially Denatured Alcohol, Fiscal Year Ended June 30, 1940. Bureau of Internal Revenue release of June 19, 1941; mimeographed.

Analysis of Miscellaneous Chemical Imports Through New York in 1940. U. S. Tariff Commission, unnumbered document; mimeographed.

Schedule B, Statistical Classification of Domestic Commodities Exported From the United States and Regulations Governing Statistical Returns of

Exports and Domestic Commodities, effective January 1, 1941 (this schedule supersedes January 1, 1939 issue); and Schedule F, Statistical Classification of Foreign Commodities Exported from the United States, Foreign Exports (Re-exports), Statistical Classification and Code Numbers of Foreign Merchandise Exported from the United States in the Same Condition as Imported, Effective January 1, 1941 (this schedule supersedes January 1, 1940, issue). Bureau of Foreign and Domestic Commerce, unnumbered document; 40 cents.

Woven Textile Fabrics, Testing and Reporting, (Third Edition). Bureau of Standards, Commercial Standard CS59-41; 10 cents.

Fuel Consumption in Manufacturing Establishments, Country as a Whole and 33 Industrial Areas, 1939. Bureau of the Census, Preliminary Report, June 9, 1941; mimeographed.

Inventories in the Hands of Manufacturers at the Beginning and End of 1939 and 1937. Bureau of the Census, Preliminary Report, June 5, 1941; mimeographed.

Safe Handling of Radioactive Luminous Compound. Bureau of Standards Handbook 27; 10 cents.

Losses of Gasoline in Storage and Handling. Bureau of Standards, Letter Circular 637; mimeographed.

Tungsten Resources of the Blue Wing District, Lemhi County, Idaho, by Eugene Callaghan and Dwight M. Lemmon. U. S. Geological Survey, Bulletin 931-A; 30 cents.

Manganese Carbonate in the Batesville District, Arkansas, by Hugh D. Miser and others. U. S. Geological Survey Bulletin 921-A; 60 cents.

Some Quicksilver Prospects in Adjacent Parts of Nevada, California and Oregon, by Clyde P. Ross. U. S. Geological Survey, Bulletin 931-B; 25 cents.

Quicksilver Deposits in San Luis Obispo County and Southwestern Monterey County, California, by E. B. Eckel and others. U. S. Geological Survey, Bulletin 922-R; 75 cents.

Geology and Mineral Resources of the Randolph Quadrangle, Utah-Wyoming, by G. B. Richardson. U. S. Geological Survey, Bulletin 923; 55 cents.

Summary of Stream-Flow Conditions During May, 1941. U. S. Geological Survey, Release of June 12, 1941; mimeographed.

Geology of the Kettleman Hills Oil Field, California, by W. P. Woodring and others. U. S. Geological Survey, Professional Paper 195; $1.50.

Supplement to List of Publications, Bureau of Mines, July 1, 1939 to June 30, 1940. Bureau of Mines, unnumbered document.

Accidents in the Oklahoma Petroleum Industry in 1937, by C. F. McCarroll. Bureau of Mines, Technical Paper 620; 15 cents.

Analyses of Washington Coals, by H. F. Yancey and M. R. Geer. Bureau of Mines, Technical Paper 618; 15 cents.

Carbonizing Properties and Petrographic Composition of Upper Freeport Coal From Morgantown District, Monongalia County, W. Va., and of Lower Freeport Coal From Eastern Indiana County Near Cambria County, Pa., by A. C. Fieldner and others. Bureau of Mines, Technical Paper 621; 15 cents.

Asphalts From Some Wyoming and Other Asphalt Bearing Crude Oils, by K. E. Stanfield. Bureau of Mines, Report of Investigations 3568; mimeographed.

Barricading as a Life Saving Measure in Connection with Mine Fires and Explosions, by D. Harrington and W. J. Fene. Bureau of Mines, Miners Circular 42; 10 cents.

Performance of Subbituminous Coal in a Typical Underfeed Domestic Stoker, by V. F. Parry and R. D. Segur. Bureau of Mines, Report of Investigations 3557; mimeographed.

Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1941, by G. R. Hopkins and E. W. Cochrane. Bureau of Mines, Information Circular 7161; mimeographed.

Drainage Characteristics of Alabama Coals, by B. W. Gandrud and G. D. Coe. Bureau of Mines, Report of Investigations 3563; mimeographed.

Differentiation of the Components of an "Explosive Oil": A Survey of the

Chemical Literature, by W. M. Thornton, Jr. Bureau of Mines, Information Circular 7155; mimeographed.

Some Information on the Causes and Prevention of Fires and Explosions in the Petroleum Industry, by G. M. Kintz. Bureau of Mines, Information Circular 7150; mimeographed.

Nonmetallic Minerals Needed for National Defense: Part 2, Abrasives, by Leo J. O'Neill. Bureau of Mines, Information Circular 7168; mimeographed.

Nonmetallic Minerals Needed for National Defense, Part 3, Nitrates, by Alvin H. Schallis. Bureau of Mines, Information Circular 7170; mimeographed.

Salient Statistics of the Coke Industry in 1940. Bureau of Mines, Monthly Coke Report No. M.C.R. 158; mimeographed.

Asphalt-Prepared Roll Roofings and Shingles. Bureau of Standards, Building Materials and Structures Report No. BMS70; 15 cents.

Sugarcane for Sirup Production, by E. W. Brandes. Department of Agriculture, Circular 284 Revised; 10 cents.

Trends in Production and Foreign Trade For Meats and Livestock in the United States, by Preston Richards. Department of Agriculture, Technical Bulletin 764; 10 cents.

Selenium Occurrence in Certain Soils in the United States, With a Discussion of Related Topics: Fifth Report, by K. T. Williams and others. Department of Agriculture, Technical Bulletin 758; 15 cents.

Vegetable Seed Treatment, by R. J. Haskell and S. P. Doolittle. Department of Agriculture, Farmers Bulletin 1862; 5 cents.

Forest Resources of South Georgia. Department of Agriculture, Miscellaneous Publication 390; 20 cents.

The Mineral Composition of Crops, with Particular Reference to the Soils on which They Were Grown, by Kenneth C. Beeson. Department of Agriculture, Miscellaneous Publication 369; 20 cents.

Asphalt (for use in) Road and Pavement-Construction, November 26, 1940. Federal Specification SS-A-706a; 5 cents.

Ink, Writing. July 12, 1940. Federal Specifications TT-I-563a; 5 cents.

Resin-Treated, Laminated, Compressed Wood, by A. J. Stamm and R. M. Seborg. Forest Products Laboratory, R1268; mimeographed.

Fire-Resistance Tests of Plywood-Covered Wall Panels, by G. C. McNaughton and C. A. Harrison. Forest Products Laboratory, R1257; mimeographed.

Administrative Procedure in Government Agencies. Senate Document 10, 77th Congress, 1st Session. Monograph of the Attorney General's Committee on Administrative Procedure, embodying the results of the investigations made by the staff of the Committee relative to the administrative practices and procedures of several agencies of the Government. In 14 parts as follows:

1. Administration of the Fair Labor Standards Act of 1938, Wage and Hour Division, Children's Bureau; 10 cents.
2. War Department; 5 cents.
3. Social Security Board; 10 cents.
4. Railway Labor, the National Railroad Adjustment Board, the National Mediation Board; 5 cents.
5. National Labor Relations Board; 10 cents.
6. Civil Aeronautics Authority; 15 cents.
7. Department of the Interior; 15 cents.
8. United States Employees' Compensation Commission; 10 cents.
9. Administration of Internal Revenue Laws, Bureau of Internal Revenue, Board of Tax Appeals, Processing Tax Board of Review; 15 cents.
10. Bituminous Coal Division, Department of the Interior; 10 cents.
11. Interstate Commerce Commission; 15 cents.
12. Federal Power Commission; 10 cents.
13. Securities and Exchange Commission; 15 cents.
14. Administration of the customs laws, United States Tariff Commission, Bureau of Customs; 15 cents.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Alloys. H. Kramer & Co., 21st and Loomis St., Chicago, Ill.—Bulletin No. 20—6-page folder on this company's aluminum bronze alloys, with illustrations, discussion, and tabulated mechanical properties as well as chemical specifications for heat-treated aluminum bronze. Also information on concern's special alloys and ingots.

Bearings. Johnson Bronze Co., 508 S. Mill St., New Castle, Pa.—4-page folder on this concern's new pre-cast "Bronze on Steel" for bearings and bushings, with illustrations and description of applications and advantages.

Belting. The B. F. Goodrich Co., Akron, Ohio—Catalog Section 2150—12-page pamphlet on "Selection and Maintenance of Rubber Transmission Belts" with detailed and valuable engineering data on grades and sizes of transmission belts, horsepower capacity, service factors, belt speeds and maintenance, storage and cleaning of rubber belts.

Cements. Smooth-On Mfg. Co., 570 Communipaw Ave., Jersey City, N. J.—Folder describing and illustrating briefly waterproofing, dustproofing and patching of concrete floors, walls, etc., by use of this concern's waterproofing cements.

Conveying. Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.—Folder No. 1912—4-page folder on this company's malleable iron and Promal elevator buckets with complete prices and dimensional data on buckets for general service, resistance to abrasion for inclined elevators, and for those handling clinging and lumpy materials.

Conveyors. The B. F. Goodrich Co., Akron, Ohio.—A catalog section on the new turnable conveyor belt put out by this company, which describes the belt's functions, design, details of construction, and proper method of turning.

Conveyors. Stephens-Adamson Mfg. Co., Aurora, Ill.—Vol. 187—20-page house organ on this concern's conveyors, elevators and transmission equipment, with numerous illustrations and detailed drawings, showing typical installations in industries of various types.

Conveyors. Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.—Book No. 1975—24-page book which gives the first description of this company's new power-operated "Bulk-Flo" conveyor system for positive and continuous conveying of flowable granular, crushed, ground or pulverized materials of a non-corrosive, non-abrasive nature, in capacities of 1-140 tons per hour. Information includes handling capacities, classification of materials that can be handled, major dimensions of basic "Bulk-Flo" sections, and similar other data.

Crushers. Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin 3112—22-page catalog on this concern's type "TY" reduction crusher with detailed and valuable engineering data on general specifications, sizes and capacities, setting dimensions, detailed drawings, and instructions for assembly, erection, lubrication, operation and repair.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B6132—32-page booklet which shows this company's latest induction motor construction for bracket and pedestal types of 250 hp. and larger and charts showing range of each type. Also covers standard motors as well as those with special protective features such as drip-proof, splash-proof, and enclosed designs, with curves showing variations of power factors and starting torques with different motor rated speeds. Several pages are devoted to induction motor control.

Electrical Equipment. American Engineering Co., 2668 Cumberland St., Philadelphia, Pa. — Catalog H40 — 26-page catalog describing construction, operation and application of this concern's monorail electric hoists, with data on capacities, speeds, heights of lift, other specifications and dimension drawings.

Electrical Equipment. Cutler-Hammer, Inc., Pioneer Electrical Manufacturers, 219 N. 12th St., Milwaukee, Wis.—A brief, non-technical bulletin on how this concern's "Multi-Breaker" eliminates the danger and bother of blown fuses in plants.

Equipment. Thermoid Rubber, Division of Thermoid Co., Trenton, N. J.—80-page engineering manual on "Thermoid" V-belt drives, covering multiple and fractional horsepower V-belts and drives and giving complete information in handy-to-use form.

Flotation. Denver Equipment Co., 1400 17th St., Denver, Colo.—Bulletin F-12B—6-page folder on this concern's unit flotation cells, with diagrammatic flow-sheet of use in gold, copper, molybdenum, and tungsten circuits, together with detailed engineering information in tabular and drawing form.

Glassware. Corning Glass Works, Corning, N. Y.—Catalog No. LP21—New 160-page catalog listing a total of approximately 2,700 items and 358 new items of this company's Pyrex and "Vycor" glassware for laboratory and other uses.

Instruments. The Bristol Co., Waterbury Conn.—Bulletin 574—4-page folder on portable recording voltmeters and ammeters supplied by this concern. Folder includes brief discussion and illustrations.

Instruments. The Brown Instrument Co., Wayne & Roberts Ave., Philadelphia, Pa.—Catalog 771—24-page catalog on this company's industrial power units and motorized valves, with cross-sectional drawings to show details of construction and extensive tabular material on dimensions and other engineering data. Also Catalog 772 on non-indicating, air-operated controllers for temperature and pressure; also accompanied by drawings and tabular data.

Instruments. The Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., Chrysler Bldg., New York, N. Y.—Form 4178—8-page folder on this company's recording and indicating industrial thermometers, accompanied by data on applications, drawings, prices, and charts showing specifications and ranges.

Instruments. The Foxboro Co., Foxboro, Mass.—Bulletin A286—Folder describing briefly and illustrating group-drive potentiometer controller in various industries.

Instruments. General Electric Co., Schenectady, N. Y.—Folder GEA 3618—2-page sheet on this company's "Zahn" viscosimeter for measuring viscosity of oils and paints, with brief description of applications, features and operation as well as prices and outline diagrams.

Instruments. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—Catalog E96(2)—8-page catalog on this company's recently announced glass-electrode pH indicator, with discussion and illustrations of operation and construction features, together with price of assembly and parts.

Instruments. Permochart Co., Edgeworth, Sewickley, Pa.—4-page folder on this company's vinylite plastic recording chart for all types of recording instruments which use circular charts, including construction details, installations and prices, with sample chart to show how ink is wiped off with damp cloth.

Instruments. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y.—Catalog 699E—34-pages on this concern's oil testing instruments

for petroleum products, giving specifications and other information on such instruments as A.S.T.M. thermometers, hydrometers, viscosimeters, etc.

Instruments. Worner Products Corp., 1019 W. Lake St., Chicago, Ill.—Bulletin No. 102—2-page sheet describing and illustrating use of this concern's electric eye for smoke detection in connection with air conditioning and ventilating systems, with emphasis on pre-warning of fires by this method of detecting smoke.

Jacks. Templeton, Kenly & Co., Chicago, Ill.—Catalog No. 41—58 pages on this company's "Simplex" jacks of all types, including descriptions, details on uses, list prices, tabular engineering and dimension data and operating principles.

Metallurgy. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 101—Bulletin on this company's enlarged laboratory facilities and equipment for research and testing on problems of separation, concentration, reclamation, etc. of mineral ores and other metallurgical products.

Oil Reclamation. Gale Oil Separator Co., Inc., **Chrysler Bldg., New York**—4-page pamphlet describing briefly system of this company for reclaiming lube and cutting oils, with data on capacities and prices.

Paints. The Sherwin-Williams Co., Cleveland, Ohio—24-page booklet on "Save-Lite", this concern's white paints. Includes general discussion of different types of white paints, paints and illumination, general characteristics, photographs showing typical applications, and technical information in chart form.

Pumps. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B6146—40-page bulletin on this company's single-stage, double-suction centrifugal pumps, giving construction features, dimensions, normal and special application data, illustrations of typical installations, and other pump engineering data.

Pumps. Beach-Russ Co., 50 Church St., New York City—Catalog No. 75—8-page booklet on this concern's rotary-piston high-vacuum pumps, with illustrations and discussion of types, sizes, construction features and engineering data on capacities, dimensions and comparative volumetric efficiencies.

Pumps. Peerless Pump Div., Food Machinery Corp., 301 W. Ave. 26, Los Angeles, Calif.—Bulletin 148—8 pages on propeller type pumps put out by this company for drainage, irrigation and flood control, and for industrial uses. Contains general description of operating principles and numerous photographs illustrating actual installations.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin W-412-B30—6-page folder describing briefly and illustrating this concern's horizontal duplex plunger power pumps, with engineering data on capacities and specifications, and drawings showing principal features and dimensions.

Safety. The Boyer-Campbell Co., 6540 Antoine St., Detroit, Mich.—4-page circular featuring 20 different models of face shields put out by this concern for protection of eyes and face from splashing, excess heat and other dangers, including welding. Each shield is described in detail and illustrated.

Safety Appliance. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Bulletin CE13—1-page sheet on this company's cool and sanitary forehead perspiration retainer for hot working conditions in industrial plants.

Scales. Stock Engineering Co., 9805 Theodore Ave., Cleveland, Ohio.—Form 15—4-page folder on this concern's automatic scale for weighing coal in steam boiler plants and elsewhere. Bulletin illustrates and describes briefly principal features of the scale.

Steels. Jessop Steel Co., Washington, Pa.—Bulletin 241—6-page folder on this concern's special type of steel designed for making molds for plastics and known as "Press E-Z" hobbing steel. Folder gives condensed information on properties, heat treatment and how dies are made from the steel.

Steels. Joseph T. Ryerson & Son, Inc., 16th & Rockwell Sts., Chicago, Ill.—1941 edition of this company's stock list, with 268 pages of complete specifications and other data on such steel materials as beams, plates, bars and strips, alloys, tool steels, tubings, welding rods, etc. Booklet contains S.A.E. standard specifications, charts showing machinability of more than 50 steels, standard gage comparisons, weight tables, and other engineering data.

Steels. Jessop Steel Co., Washington, Pa.—Bulletin 141—8-page folder on this concern's new process cold header die steel for cold heading bolts, screws, rivets, etc., with brief description of uses, properties, and specifications. Also includes other information.

Tape. B. F. Goodrich Co., Akron, Ohio—Catalog Section 9270—4-page catalog section on this concern's two-in-one tape for maintenance and electrical appliance service. Describes and illustrates uses of the tape in various industries, methods of application and specifications.

Tower Packing. General Refractories Co., Philadelphia, Pa.—12-page pamphlet issued by this company on its acid proof brick and tile for tower packing. Included are data on dimensions, applications in various chemical and other operations, with valuable information in chart form on the relative value of different types of tower packings.

Tubes. Babcock & Wilcox Tube Co., Beaver Falls, Pa.—Card No. 107A—a new and revised list of standard specifications for seamless tubes and pipes arranged in convenient form. Also No. 113, letter-sized card with data on maximum allowable working pressures for seamless tubes, nipples or flues for water-tube boiler and fire-tube boilers. Other data also included.

Valves. Jenkins Bros., 80 White St., New York—32-page catalog on construction, selection, and applications of valves, drains and by-passes, including list of company's valves meeting A.S.M.E. power boiler code. Includes instructive cross-sectional drawings and tabular engineering and specification data.

Valves. Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa.—Bulletin No. V-135—Bulletin showing various port and stop arrangements provided by this concern's multiport valves in sizes ranging from ⅛ in. to 16 in. and for pressures to 3,000 lb., including illustrations of the different types, specification tables, and arrangement of flowways, ports and degrees of turn for the various types.

Valves. Reed Valve Div., Reed Roller Bit Co., Houston, Tex.—Catalog 41—1941 catalog, containing 80 pages, on this company's valves of many types, containing description of valve materials and alloys, and detailed and extensive engineering data for service pressure ratings of various valves at different temperatures, as well as dimensions, list prices, service recommendations, diagrams and illustrations, together with 40 pages of engineering data on friction of air in pipes, properties of steam, conversion factors, spacing of pipe supports and other similar information.

Varnishes. Irvington Varnish & Insulator Co., Irvington, N. J.—34-page manual on this concern's insulating varnishes, with data on selection and application, characteristics, uses and types, accompanied by photographs, charts and tables. Subject matter describes 31 different insulating varnishes, paints and enamels.

Ventilation. Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill.—Catalog No. 141—Catalog on this concern's propeller fans, automatic shutters, power roof ventilators, volume blowers, with specifications, illustrations, diagrams and methods of rating. Includes a description of this concern's special self-cooled motor.

Water Treatment. Elgin Softener Corp., Elgin, Ill.—Bulletin 605—4-page folder on this company's Zeolite water softeners using a new method of controlling distribution and flow of water. Includes drawings to show structural details and general discussion of applications.

PRODUCTION AND CONSUMPTION OF CHEMICALS MAKE NEW RECORDS DESPITE SHORTAGES IN RAW MATERIALS

Chem & Met ECONOMICS and MARKETS

Despite labor and transportation problems, raw material shortages, and other restrictions, production and consumption of chemicals continue to make new monthly records. Consumption not only is keeping pace with production but is hampered because materials are not available in still larger supply. Seasonal influences have been largely eliminated but are still effective in a few directions, notably the fertilizer industry where some slowing down has been reported in the last two months. The preliminary weighted index for consumption of chemicals for June is 161 which compares with revised figures of 165.33 for May and 161.96 for April. Corresponding index numbers for last year were 137.86, 141.35, and 132.99 respectively.

Chem. & Met.'s Weighted Index For Chemical Consumption

	April revised	May
Fertilizer	31.54	28.00
Pulp and paper	22.00	22.90
Petroleum refining	14.84	15.34
Glass	15.30	15.90
Paint and varnish	16.86	18.96
Iron and steel	12.72	13.35
Rayon	11.90	12.30
Textiles	11.22	11.15
Coal products	8.64	9.18
Leather	4.60	4.85
Explosives	4.67	5.53
Rubber	4.05	4.12
Plastics	3.62	3.75
	161.96	165.33

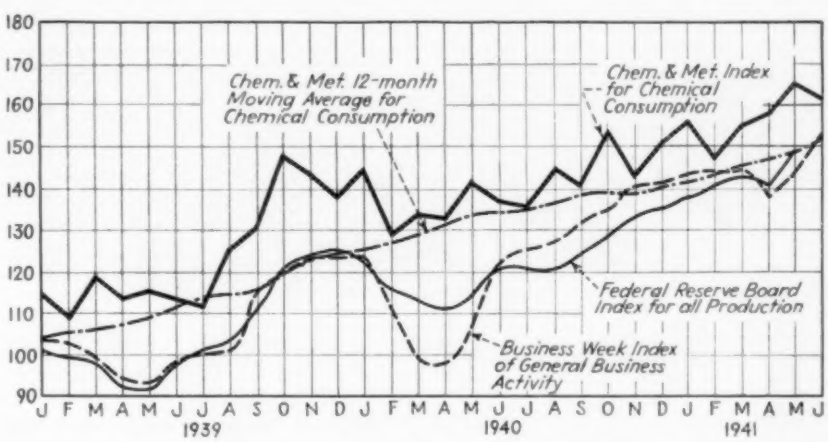
Direct influences of the defense program are becoming more of a factor in the market for chemicals as production of explosives and other military goods is being speeded up. Some industrial lines are reaching a point where they have passed their peak operating rates either because they have been ordered to curtail outputs, because their supply of basic raw materials has been reduced by official order, or because priorities have diverted their supply of materials into more essential lines of production.

While the number of industries whose outputs will be arbitrarily cut down, is small, the effect of allocating raw materials will be widespread and manufacturing activities at some plants promise to proceed in almost direct inverse ratio to the ascending rate scheduled for plants turning out products of military importance. This carries a two-fold significence as it will limit production of certain chemicals and at the same time curtail production of the finished products which require these affected chemicals. This does not mean that overall production of chemicals will decline. On the contrary, new plants and plant additions now in operation—both government and private—together with plants building and prospective, promise larger outputs than have yet been attained.

The plastics industry already has felt the effects of a shortage in formaldehyde but it is noted that the drop in some plastics outputs has been offset by increased production of other types. For instance, production of cellulose acetate molding compounds in May amounted to nearly 2,320,000 lb. and for the first five months of this year it reached a total of 10,315,967 lb. compared with 5,096,686 lb. for the corresponding period of last year.

Reports from the principal chemical-consuming lines through June indicate that to date the raw material situation has not checked expansion of production, rather it has merely prevented production from being enlarged enough to fill all orders. Daily runs of petroleum to stills were at a record level in the closing week of June. Steel mills were running at close to capacity. Glass makers have been called upon to take up the slack caused by a drop in production of tin containers and the May output of glass containers was by far the largest for any month in the history of the trade. Rayon producers are practically bare of surplus stocks and are unable to meet all demands for yarn. Staple production has been increased but the lack of imports has been felt.

The movement of commodities in the third quarter of this year, according to the 13 Shippers Advisory Boards will be 14.8 percent above those for the comparable period of last year. This estimate is based on prospective carloading requirements. Increases are anticipated for all sections of the country. Gains in percent for some of the individual groups are: automobiles, trucks, and parts, 54.9; chemicals and explosives, 25.2; iron and steel, 16.5; paper, paperboard, and prepared roofing, 16.5; cotton, 15.1; and fertilizers, 9.1.

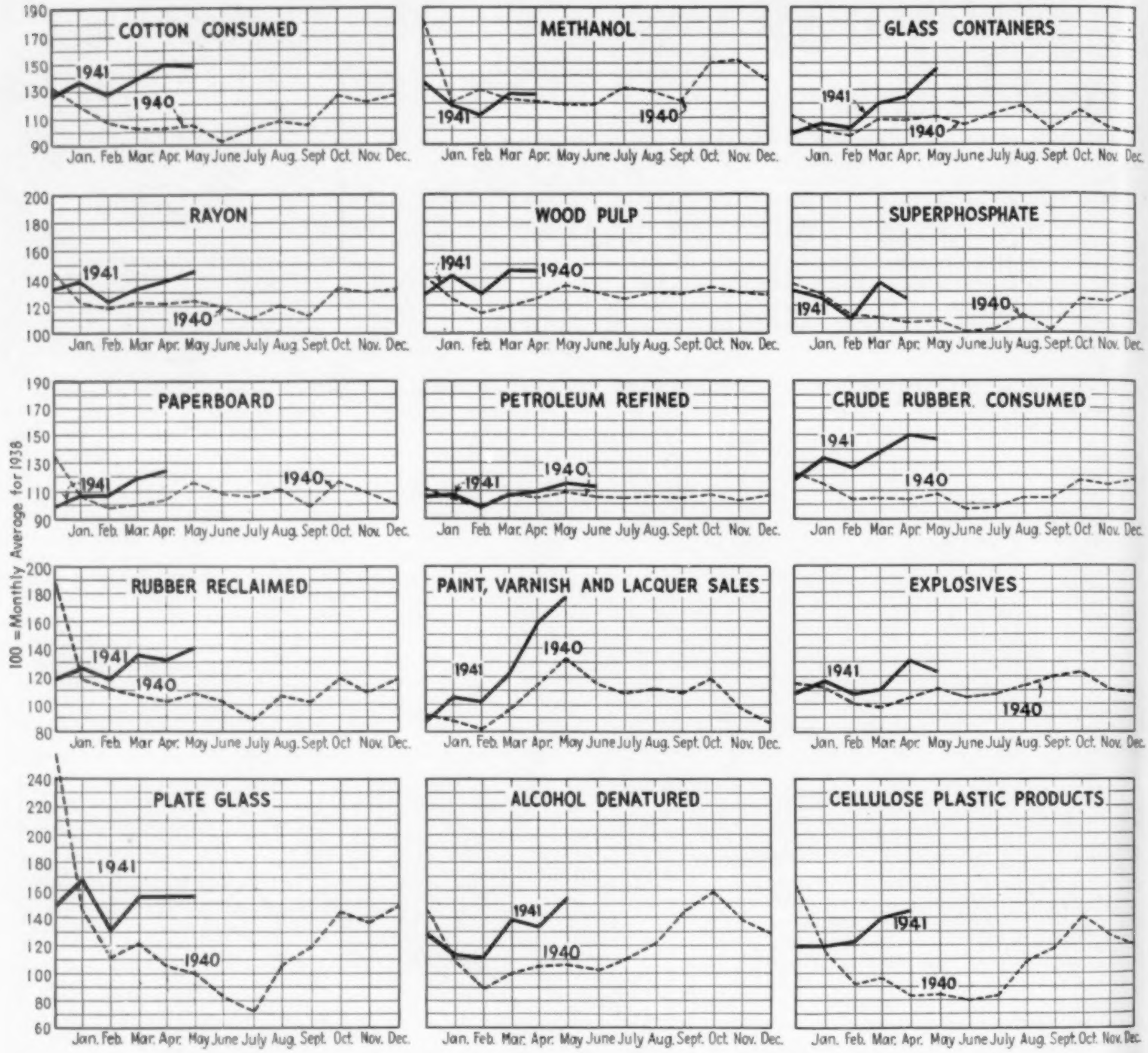


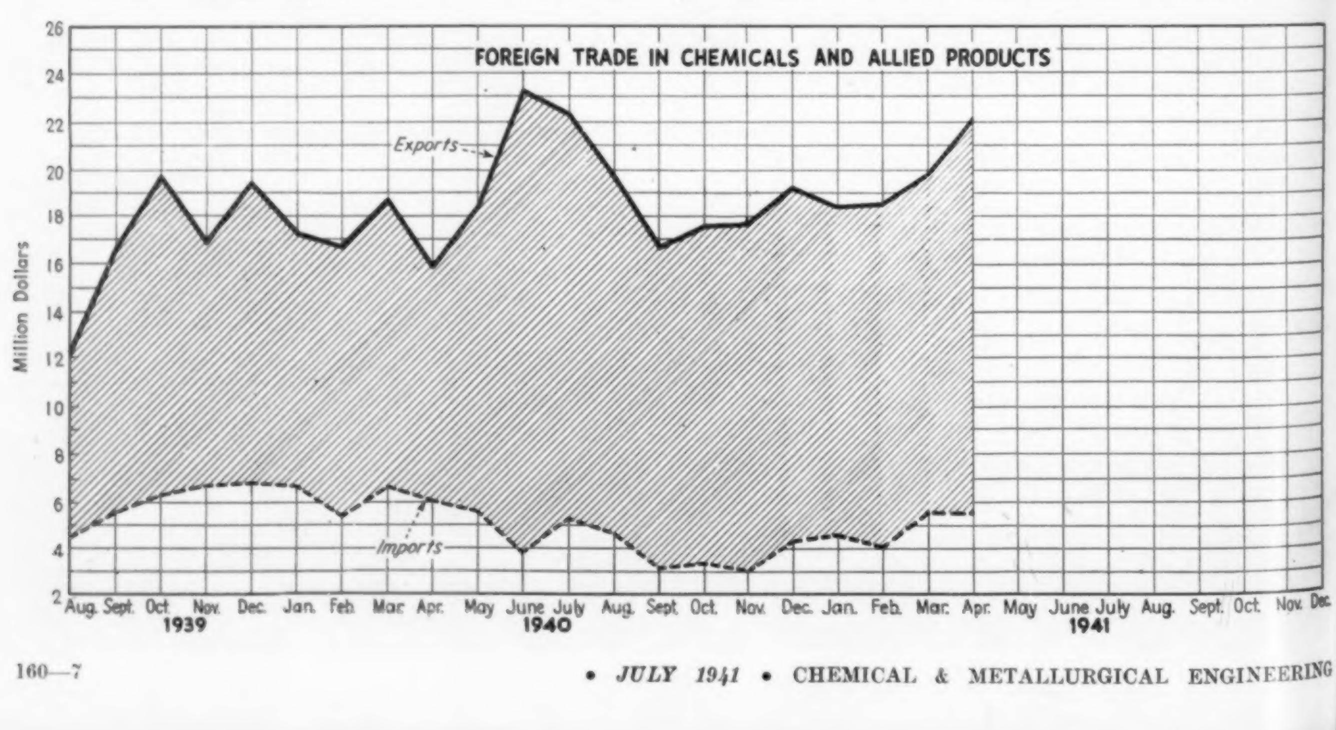
Production and Consumption Data for Chemical-Consuming Industries

Production	May 1941	May 1940	January-May 1941	January-May 1940	Per cent of gain for 1941
Alcohol, ethyl, 1,000 pr. gal	29,606	20,948	127,303	103,183	23.4
Alcohol denatured, 1,000 wi. gal	14,714	10,037	61,726	48,414	27.5
Automobiles, no	518,736	391,215	2,475,315	2,083,892	15.8
Ammonia, liquor, 1,000 lb.[1]	5,358	4,440	26,024	22,705	19.0
Ammonium sulphate, tons[1]	61,495	57,781	306,964	282,602	9.3
Benzol, 1,000 gal.[1]	12,085	10,397	61,934	51,141	21.1
Toluol, 1,000 gal.[1]	2,483	....	11,515	....	....
Naphthalene, 1,000 lb.[1]	6,654	....	32,947	....	....
Byproduct coke, 1,000 tons	4,846	4,256	23,755	21,137	12.4
Glass containers, 1000 gr	6,246	4,701	25,581	22,277	14.8
Plate glass, 1,000 sq. ft	18,394	11,721	90,018	68,822	30.8
Window glass, 1,000 boxes	1,282	1,068	7,057	5,710	23.6
Pyroxylin spread, 1,000 lb	7,351	4,102	33,296	23,706	40.4
Rubber reclaimed, tons	22,775	17,499	106,274	88,376	20.3
Consumption					
Cotton, bales	918,902	641,636	4,330,123	3,285,492	31.8
Silk, bales	22,440	18,997	128,342	114,413	12.2
Explosives, 1,000 lb	37,891	34,475	175,310	162,593	7.8
Rubber, crude, tons	71,187	54,513	340,266	269,467	27.0
Rubber reclaimed, tons	21,353	15,163	99,299	80,727	23.0

[1] Byproduct coke production.

Production and Consumption Trends





Why Aren't *ALL* Motors Copperspun?

● It's an accepted fact that the one-piece rotor with windings centrifugally cast of SOLID COPPER makes the best squirrel-cage motor. For only in this rotor are the advantages of one-piece winding combined with the advantages of copper.*

Why, then, aren't Copperspun rotors used in *all* such motors? It's not because *only* Fairbanks-Morse has attempted to produce rotors of this type . . . the advantages are too widely recognized for that. It's because *only Fairbanks-Morse has succeeded.*

It took a great deal of time and money to find and perfect practical means of commercial production. But the result is worth the cost . . . F-M Motors with patented features available only in Copperspun rotors can help reduce operating and production costs. Their plus values challenge investigation if you desire the most for your equipment dollar. Write Fairbanks, Morse & Co., Dept. G19, 600 S. Michigan Avenue, Chicago, Illinois. Branches and service stations throughout the United States and Canada.

**Copper has a high melting point (2000° F as compared with 1100° F for aluminum), higher electrical conductivity, and better thermal expansion characteristics.*

FAIRBANKS-MORSE F M MOTORS

DIESEL ENGINES ELECTRICAL MACHINERY RAILROAD EQUIPMENT WASHERS-IRONERS STOKERS PUMPS FAIRBANKS SCALES WATER SYSTEMS FARM EQUIPMENT AIR CONDITIONERS

INCREASED DEMAND FOR CHEMICALS TAXES PRODUCTIVE CAPACITIES WITH SHORTAGES REPORTED

As the year advances it becomes more apparent that the record call for chemicals is running ahead of the productive capacity of plants. With defense program requirements given preference in many cases, industrial users of chemicals are finding it increasingly difficult to obtain supplies in volume sufficient to take care of the abnormal needs of their customers. Considerable publicity has been given to the scarcity of materials for making certain types of plastics. While methanol outputs have been speeded up somewhat, the supply still remains short and naturally this is reflected in the market for formaldehyde. For some time the chlorine output has been sold ahead and reports from Canada indicate a shortage of chlorine in that country. Dry color manufacturers are likewise reported as being adversely affected by the raw material situation. Paint manufacturers have been forced to make adjustments because of changes in supplies of drying oils. However, considerable progress has been made in the way of developing substitutes for the customary drying oils and the Department of Agriculture is conducting research work which may result in further relief. The important metals are under some kind of control which has a direct bearing on the salts. The Driector of Priorities has stipulated that the amount of metallic zinc to be set aside in July in an emergency pool will equal 22 percent of May production. Also that producers of zinc oxide will be required to set aside 10 percent of May production, which means about 1,500 tons. The July production of zinc dust will not be under regulation. These reports offer the best summary of current market conditions and point to the conclusion that as government needs increase, the supply of chemicals for industry will be further compressed.

A second important factor in the present market is concerned with prices. In the first place rumors have been current to the effect that a price-control unit would be established to govern the chemical industry. Some devolpments in the way of price regulation includes: the request that sellers of sulphate of ammonia maintain the present quotations; refiners and marketers of petroleum products have been requested not to make further price advances except after consultation with the Office of Price Administration and Civilian Supply; ceiling prices have been established on rubber tires and tubes in the wholesale and retail trade; six leading types of cotton cloth have come under price regulation and the same holds true for combed cotton yarn. Price control for cotton yarn does not extend to sales made for export and there is some speculation whether this establishes a precedent which will grant an open export market for commodities.

Various factors have combined to create a stronger price position for the majority of chemicals. Labor and raw material costs have advanced and in many cases transportation costs have been higher. Many materials formerly moved by water are now finding it necessary to pay higher rates for rail transportation. Reports also are heard that shortage of cars is influencing some railroads to favor carlot business to the detriment of less carlot shippers who are asked to make use of trucks. It is noted that price advances for chemicals were more numerous in the last month and while producers have kept average price levels within a narrow compass from the time hostilities broke out in Europe, it is evident that profit margins have been jeopardized by the rising trend of production costs.

Prices for oils and animal fats continued on an upward curve throughout June but with the turn of the month notice was given that values for cottonseed oil were under investigation and a high mark considerably under the prevailing price level would be imposed. This brought a sharp reaction and in the early part of the month quotations in the futures market in the New York Produce Exchange were reduced daily by the full limit of 100 points. The effect of this price reversal was immediately apparent in the position of other oils and fats and recessions were fairly general. Paint-making oils, however, maintained a strong price position with some of them in small supply. New crop prospects for the growing flaxseed crop are reported as favorable and a continuance of good growing conditions undoubtedly would give a larger outturn of seed for the coming season.

Sodium sulphate was exported from Chile to the amount of 6,860 metric tons in the first four months of 1941—a considerable increase over the 1,675

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base = 100 for 1937

This month	101.17
Last month	100.49
July, 1940	98.60
July, 1939	97.02

Price changes were more numerous in the last month with several advances becoming effective for July forward deliveries. In addition to higher production costs, outputs are well sold ahead and shortages are becoming more apparent which adds to the price tone.

tons recorded in the corresponding months of 1940. The United States continued to be the chief purchaser during the 1941 period, taking 5,873 tons. Brazil took 526 and Argentina 365.

Casein exports from Argentina totaled 13,534 metric tons during the first five months of 1941. Of this amount 8,963 tons were shipped to the United States. These exports compare with 6,098 tons exported in the corresponding five months of last year during which 2,550 tons were shipped to the United States. So far no major difficulty has been experienced in obtaining shipping space.

Cinnabar, the common ore of mercury, deposits located in the Torres District of the State of Lara, Venezuela, are alleged to have been acquired recently by Caracas interests. The ore is said to have a mercury content of 7.86 percent. Negotiations for the purchase of necessary equipment, including reduction machinery and supplies, are said to be under way. The plant is expected to start operation this month.

A number of chemicals are included for the first time on the latest Army-Navy critical priorities list. Items on this list are automatically given priority ratings when purchased by the service organizations and other Governmental defense units.

The Federal Government has decided to make ingot aluminum in Australia. Australian bauxite will be used as far as possible, and it is hoped that Australia will eventually be self-contained for aluminum supplies.

When war began comparatively few bauxite deposits suitable for commercial purposes were known; but investigations suggest that adequate supplies of good quality are available. Initial plant and equipment for aluminum production will cost about $5,000,000.

Alumite deposits in the Lake Campion area, Western Australia, are estimated to contain 16,000,000 tons of clay, of which 60 percent is alumite. The yield is estimated at 1,750,000 tons of potassium sulphate 3,250,000 tons of alumina, and 750,000 tons of sulphur.

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 1937

This month	**119.58**
Last month	112.00
July, 1940	72.37
July, 1939	70.33

The price trend continued sharply upward until the end of June when price regulation of cottonseed oil brought about drop in values. The advance, however, was soon resumed and new highs reached as the month advanced.

Chem & Met Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.08½–$0.09	$0.07½–$0.08	$0.07½–$0.08
Acid, acetic, 28%, bbl., cwt	3.18 – 3.43	2.23 – 2.48	2.23 – 2.48
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. Reagent	10.25 –10.50	10.25 –10.50	10.25 –10.50
Boric, bbl., ton	106.00 –111.00	106.00 –111.00	106.00 –111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.05 – 1.15	.90 – 1.00	.90 – 1.00
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.10¾– .12	.10¾– .12	.10¾– .12
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.64 – .66	.54 – .56	.54 – .56
Tartaric, powd., bbl., lb	.63 –......	.63 –......	.39¼–......
Tungstic, bbl., lb	nom.......	nom.......	nom.......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.121–......	.111–......	.101–
Alcohol, Butyl, tanks, lb	.10 –......	.09 –......	.09 –......
Alcohol, Ethyl, 190 p'f., bbl., gal	6.04 –......	6.04 –......	5.98 –......
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, dr., gal. wks.	.33 –......	.33 –......	.29½–......
Alum, ammonia, lump, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb	.03¾– .04	.03¾– .04	.03¾– .04
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.85 – 2.10	1.60 – 1.70	1.60 – 1.70
Aqua ammonia, 26°, drums, lb	.02¼– .03	.02¼– .03	.02¼– .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.16 –......
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09 – .12	.09 – .12	.09 – .12
Sulphate, wks., cwt	1.45 –......	1.45 –......	1.40 –......
Amylacetate tech., from pentane, tanks, lb	.115–......	.10½–......	.10½–......
Antimony Oxide, bbl., lb	.12 –......	.12 –......	.12 –......
Arsenic, white, powd., bbl., lb	.03¾– .04	.03½– .04	.03 – .03½
Red, powd., kegs, lb	nom.......	nom.......	.17 – .18
Barium carbonate, bbl., ton	55.00 –60.00	52.50 –57.50	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.09½– .10	.09½– .10	.08½– .10
Blanc fixe, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	43.00 –......	43.00 –......	43.00 –51.00
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –......	1.90 –......	1.90 –......
Arsenate, dr., lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Carbide drums, lb	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	19.00 –24.50	19.00 –24.50	19.00 –24.50
flake, dr., del., ton	20.50 –25.00	20.50 –25.00	20.50 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05 – .06	.05 – .06	.05 – .06
Tetrachloride drums, lb	.04¾– .05½	.04¾– .05½	.04¾– .05½
Chlorine, liquid, tanks, wks., lb	1.75 –......	1.75 –......	1.75 –......
Cylinders	.05¼– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.c.b. wks, ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.10 – .16½	.10 – .16½	.10 – .16
Sulphate, bbl., cwt	4.75 – 5.00	4.75 – 5.00	4.60 – 4.85
Cream of tartar, bbl., lb	.52 –......	.52 –......	.34¼–......
Diethylene glycol, dr., lb	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt	1.80 – 2.00	1.80 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb	.08½–......	.07½–......	.07 –......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06½	.05½– .06
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, drums, lb	.17½– .19	.16 – .17	.16 – .17
Glaubers salt, bags, cwt	1.05 – 1.10	.95 – 1.00	.95 – 1.00
Glycerine, c.p., drums, extra, lb	.14½–......	.14½–......	.12½–......
Lead:			
White, basic carbonate, dry casks, lb	.07½–......	.07½–......	.07 –......
White, basic sulphate, sck., lb	.07¼–......	.07¼–......	.06½–......
Red, dry, sck., lb	.0835......	.0835......	.07½–......
Lead acetate, white crys., bbl., lb	.12 – .13	.12 – .13	.11 – .12
Lead arsenate, powd., bag, lb	.09½– .11	.09½– .11	.08½– .11
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, pwd., csk., lb	.0735......	.0735......	.06½–......
Lithopone, bags, lb	.0385– .04	.0385– .04	.036– .04
Magnesium carb., tech., bags, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½

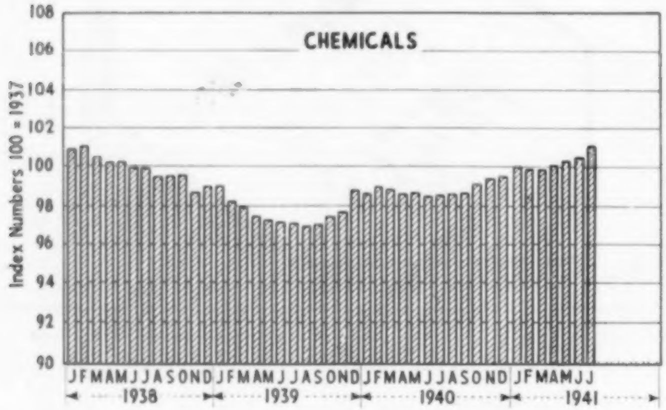
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 11

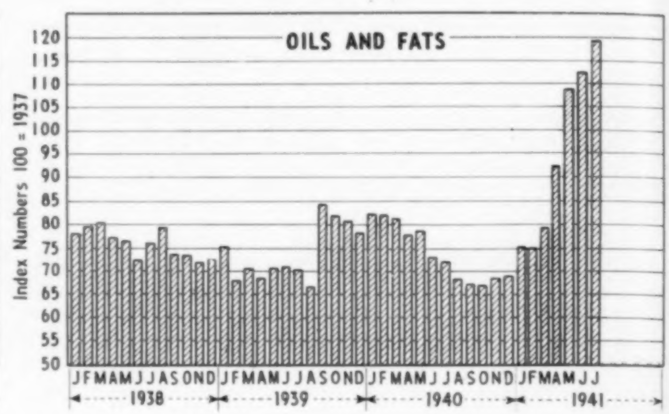
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.38 –......	.29 –......	.29 –......
97%, tanks, gal	.39 –......	.30 –......	.30 –......
Synthetic, tanks, gal	.30 –......	.30 –......	.30 –......
Nickel salt, double, bbl., lb	.13¼– .13½	.13¼– .13½	.13 – .13½
Orange mineral, csk., lb	.11¼–......	.11¼–......	.10¼–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09¾– .10	.09¾– .10	.08¾– .09
Carbonate, 80–85%, calc. csk., lb	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb	.07 – .07¼	.07 – .07¼	.07 – .07¼
Muriate, 80% bags, unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.18½– .19
Prussiate, yellow, casks, lb	.17 – .18	.16 – .17	.15 – .16
Sal ammoniac, white, casks, lb	.0515– .06	.0515– .06	.05½– .06
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –......	17.00 –......	23.00 –......
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, works, bbl., lb	.04½– .05	.04 – .05	.04 – .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07⅜– .08	.07⅜– .08	.06⅛– .07
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	15.00 –16.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.07 – .08	.07 – .08	.07 – .08
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.35 – 2.40	2.35 – 2.40	2.35 – 2.40
Nitrate, bulk, cwt	1.45 –......	1.45 –......	1.45 –......
Nitrite, casks, lb	.06¾– .07	.06¾– .07	.06¾– .07
Phosphate, tribasic, bags, lb	2.35 –......	2.35 –......	2.25 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.) wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb	.03 – .03½	.02¾– .03	.02¾– .03
Sulphite, crys., bbl., lb	.02¼– .02½	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	16.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb	.55 –......	nom.......	.51 –......
Crystals, bbl., lb	.39½–......	.39 –......	.39½–......
Zinc, chloride, gran., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.09¾–......	.09¾–......	.08¼–......
Zinc oxide, lead free, bag, lb	.06½–......	.06½–......	.06¼–......
5% lead sulphate, bags, lb	.06⅜–......	.06⅜–......	.06¼–......
Sulphate, bbl., cwt	3.15 – 3.25	3.15 – 3.25	2.75 – 3.00

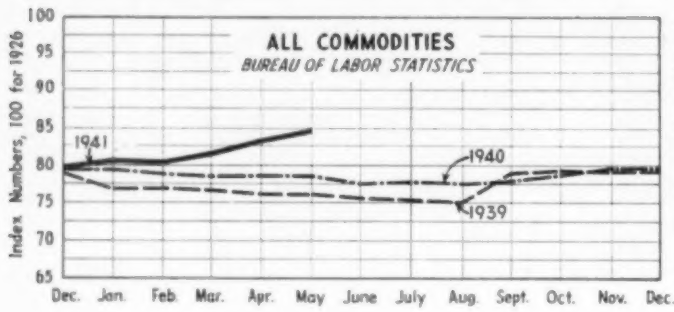
OILS AND FATS

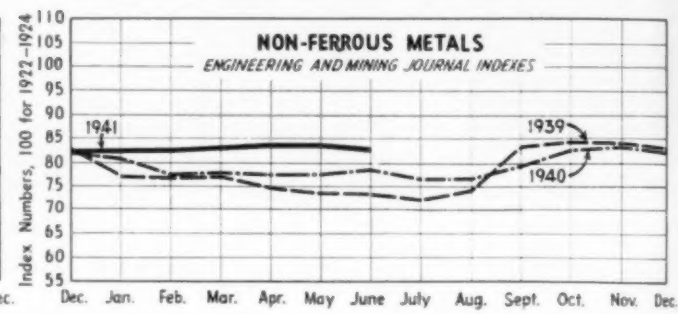
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.11 –$0.11¾	$0.11 –$0.11¾	$0.11½–$0.12
Chinawood oil, bbl., b	.32 –......	.32 –......	.25 –......
Coconut oil, Ceylon, tank, N. Y., lb	.07 –......	.07 –......	.03½–......
Corn oil crude, tanks (f.o.b. mill), lb	.12 –......	.10¼– .05½	.05½–......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.10½–......	.09½–......	.05¾–......
Linseed oil, raw car lots, bbl., lb	.113–......	.107–......	.094–......
Palm, casks, lb	.06¾–......	.05¾–......	.04½–......
Peanut oil, crude, tanks (mill), lb	.12 –......	.09¾–......	.05½–......
Rapeseed oil, refined, bbl., lb	.15 –......	.12 –......	.12 –......
Soya bean, tank, lb	.10 –......	.09½–......	.04¾–......
Sulphur (olive foots), bbl., lb	.16 –......	.14½–......	.09 –......
Cod, Newfoundland, bbl., gal	nom.......	nom.......	nom.......
Menhaden, light pressed, bbl., lb	.104–......	.10 –......	.071–......
Crude, tanks (f.o.b. factory), gal	.60 –......	.50 –......	.33 –......
Grease, yellow, loose, lb	.07¼–......	.07¼–......	.04 –......
Oleo stearine, lb	.09½–......	.09½–......	.06 –......
Oleo oil, No. 1	.10½–......	.10½–......	.06¾–......
Red oil, distilled, dp.p. bbl., lb	.10½–......	.10½–......	.06½–......
Tallow extra, loose, lb	.07¾–......	.07¾–......	.04¾–......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb.	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb.	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb.	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal.	.14 –	.14 –	.15 – .....
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.10¼– .10¾	.09¾– .10	.09½– .10
Cresylic acid, dr., wks., gal.	.76 – .78	.58 – .60	.58 – .60
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb.	.18 – .19	.15½– .16	.15½– .16
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. fob wks., lb.	.70 –	.70 –	....
H-acid, bbl., lb.	.45 – .50	.45 – .55	.45 – .50
Naphthalene, flake, bbl., lb.	.07 – .07¼	.07 – .07¼	.07 – .07¼
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb.	.12½–	.12 –	.13 – .....
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal.	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs, lb.	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal.	.27 –	.27 –	.27 – .....
Tolidine, bbl., lb.	.96 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal.	.32 –	.30 –	.30 – .....
Xylol, com, tanks, gal.	.26 –	.26 –	.26 – .....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech, bbl, lb.	.21½– .22	.21 – .22	.11½– .13
China clay, dom., f.c.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335– .30	.03¼– .30	.028– .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb.	.11 – .26	.11 – .26	.10 – .26
Chrome green, bbl., lb.	.21½– .30	.21½– .30	.21 – .27
Carmine, red, tins. lb.	4.60 – 4.75	4.60 – 4.75	4.85 – 5.00
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	3.20 – 3.25	3.20 – 3.25	nom
Chrome yellow, C.P., bbl., lb.	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b.N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 – .10	.08 – .10	.06 – .06½
Gum copal Congo, bags, lb.	.08 – .30	.08 – .30	.06 – .30
Manila, bags, lb.	.09 – .15	.09 – .14	.09 – .14
Damar, Batavia, cases, lb.	.10 – .22	.10 – .20	.08 – .24
Kauri, cases, lb.	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. mines), ton.	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton.	65.00 –	65.00 –	65.00 – .....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	nom	nom	.03 – .04
Rosin, H., 100 lb.	2.62 –	2.48 –	2.22 – .....
Turpentine, gal.	.51½–	.47¾–	.33¼– .....
Shellac, orange, fine, bags, lb.	.38 –	.34 –	.26 – .....
Bleached, bonedry, bags, lb.	.35 –	.31½–	.25 – .....
T. N. Bags, lb.	.28 –	.24 –	.13½– .....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o b. Ga.), ton.	6.00 – 8.00	6.00 – 8.00	7.50 –11.00

Industrial Notes

VIRGINIA-CAROLINA CHEMICAL CORP., Richmond, Va., has appointed M. E. Hunter assistant general sales manager. Mr. Hunter had previously acted as manager of the Columbia, S. C., and Montgomery, Ala. offices.

TIMKEN ROLLER BEARING CO., Canton, Ohio, has promoted C. M. Maratta to the position of chief works engineer left vacant by the recent death of W. C. Makley.

MITCHEL-CATHER, INC., New York, has moved its office in Houston, Texas, to the Esperson Bldg., and its office in Tulsa, Okla., has been moved to the Petroleum Bldg.

JESSOP STEEL CO., Washington, Pa., recently opened a branch office in Philadelphia and H. E. Doughty has been placed in charge with headquarters at 225 South 15th St.

ALLEGHENY LUDLUM STEEL CORP., Pittsburgh, has appointed Melvin C. Harris to the newly created position of district manager of its plants in the Pittsburgh area.

THE DELTA-STAR ELECTRIC CO., Chicago, is now represented in Detroit by the Wise Equipment Co., General Motors Bldg.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has placed R. M. Cleveland in charge of its Boston office to replace W. A. Finn who has been called to active duty with the Navy.

COPPERWELD STEEL CO., Warren, Ohio, has advanced Norman L. Deuble to the position of manager of sales.

KOPPERS CO., Pittsburgh, announces that G. C. Stephenson who has been in charge of sales of creosote will now act as sales manager of the tar and chemical division.

J. A. CASEY CO., New York, for many years prominent in the naval stores trade has again come into corporate existence with Harry W. Siebert of the old company as president. Offices are at 90 West St.

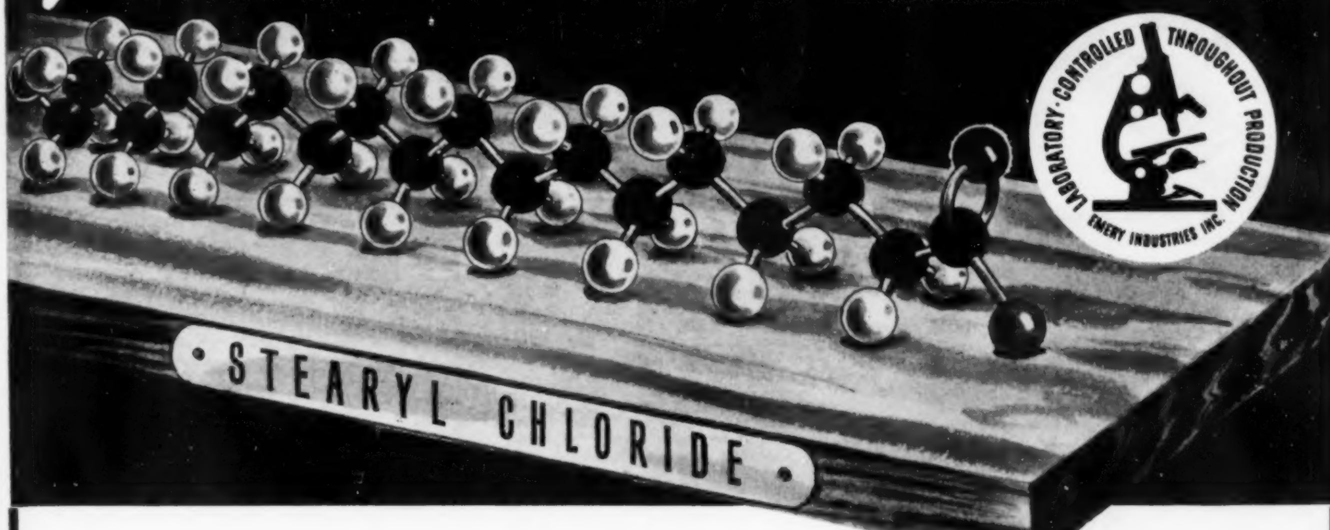
YORK ICE MACHINERY CORP., York, Pa., has moved its export division from Brooklyn to the main factory offices in York.

CHICAGO PNEUMATIC TOOL CO., New York, announces that James P. Gillies has been added to its general sales staff.

MICRO-WESTCO., Bettendorf, Iowa, has promoted H. L. McNally to sales manager of its pump division.

PANGBORN CORP., Hagerstown, Md., has moved its office in Philadelphia to 3701 North Broad St. Forrest G. Sharpe has been appointed sales engineer to succeed William T. Randall who died in April.

Meet STEARYL CHLORIDE!



This new Emery product is the acid chloride of commercial stearic acid — containing approximately 55% of C_{16} acids and 45% of C_{18} acids.

***Molecular weight*—Average: 288**

Formula:

$$\begin{array}{c}
\mathrm{H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H} \\
\mathrm{H\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C\text{-}C}\begin{matrix}{=}O \\ {\diagdown}Cl\end{matrix} \\
\mathrm{H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H\ H}
\end{array}$$

Physical Properties

Appearance	—light yellow liquid
Odor	—pungent
Melting Point	—begins to solidify at 12°C.
Specific Gravity	—0.911 at 20°C.
Purity	—98% acid chloride content

Chemical Properties

Stearyl chloride exhibits all the properties of the acyl halides, although, in general, it reacts somewhat more slowly than the lower molecular weight acid chlorides. It is decomposed only slowly by water at 30°C, but rapidly at 100°C.

Stearyl chloride is capable of reacting with hydroxyl groups to form esters or anhydrides, with amines to form substituted amides, and can be employed in the Friedel Crafts synthesis.

Its use is suggested where it is desirable to utilize the flexibility and trend towards oil solubility imparted by a long hydrocarbon chain.

Stearyl chloride is now available in quantities sufficient for laboratory and small scale testing. Larger quantities can be made available as required.

Our Chemical Service Department will gladly co-operate with you to determine the applicability of Stearyl Chloride to your own needs.

EMERY INDUSTRIES

INCORPORATED, CINCINNATI, OHIO

All Grades Stearic Acid
All Grades Elaine Oleic Acid
Fatty Acids
Fatty Acid Derivatives
Twitchell Worsted Oils
Twitchell Fat-Splitting Reagents
Twitchell Emulsifying Agents
Twitchell Rayon Oils

Twitchell Finishing Oils (for regular or Sanforized finishes)

W A R E H O U S E S   I N   P R I N C I P A L   C I T I E S

Chem & Met New CONSTRUCTION

	Current Projects — Proposed Work	Current Projects — Contracts	Cumulative 1941 — Proposed Work	Cumulative 1941 — Contracts
New England	$1,250,000	....	$2,525,000	$8,127,000
Middle Atlantic	305,000	$1,090,000	13,395,000	28,662,000
South	17,100,000	33,675,000	29,693,000	45,278,000
Middle West	140,000	40,000	3,825,000	6,282,000
West of Mississippi	1,200,000	28,450,000	11,455,000	45,823,000
Far West	295,000	101,000	1,497,000	5,397,000
Canada	240,000	765,000	850,000	935,000
Total	$20,530,000	$64,121,000	$63,240,000	$140,504,000

PROPOSED WORK

Ark., El Dorado—Lion Oil Refining Co., El Dorado, plans to construct a plant for the manufacture of natural gasoline. Estimated most $400,000.

Calif., San Francisco—American Lubricants Co., 1525 Folsom St., San Francisco, plans to enlarge its plant. Estimated cost $45,-000.

Conn., Naugatuck—U. S. Rubber Co., Naugatuck Chemical Div., Maple St., plans to construct a plant for the manufacture of synthetic rubber. Estimated cost including equipment $1,250,000.

Del., Wilmington—Mentholatum Co., West St., will soon award the contract for a factory. G. M. Whiteside, du Pont Bldg., Wilmington, Archt. Estimated cost including equipment will exceed $40,000.

Ill., Chicago—American Varnish Co., 1140 North Branch St., plans to construct a 3 story addition to its factory. Bids are now being received by Engineering Systems, Inc., Archt., 221 North La Salle St. Estimated cost $100,000.

Ky., Louisville—Park & Tilford Distillers of Ky., Inc., 35th and Ryler Sts., plans to construct an 8 story, 114x288 ft. warehouse. Thomas J. Nolan & Son, Kentucky Home Life Bldg., Archts.

La., Lake Charles—Mathieson Alkali Works, Lake Charles, plans to construct a new plant unit. Estimated cost $6,500,000.

La., Monroe—War Dept., 20th and Constitution Aves., Wash. ,D. C., plans to construct a plant for the manufacture of anhydrous ammonia here. Estimated cost $16,750,000.

La., Sterlington—Commercial Solvents Corp., 17 East 42nd St., New York, N. Y., plans to construct an ammonia manufacturing plant here. Estimated cost $10,000,000.

Md., Baltimore—Procter & Gamble, 1400 Marriott St., will soon take bids for the construction of three warehouses—1 story, 100x 140 ft., 40x140 ft. and 50x100 ft. H. K. Ferguson Co., Hanna Bldg., Cleveland, O., Archts.

Mo., Louisiana—War Dept., 20th and Constitution Aves., Wash., D. C., plans to construct a plant here for the manufacture of anhydrous ammonia. Estimated cost $16,750,000.

N. J., Clifton and Nutley—Hoffman LaRoche, Inc., Kingsland Rd., Nutley, plans to construct three chemical manufacturing buildings of various dimensions. Fellheimer & Wagner, 155 East 42nd St., New York, N. Y., Archts.

N. Y., Niagara Falls—Niacet Chemical Co., Pine Ave. and 47th St., plans to rebuild portion of vanyl-acetate plant recently destroyed by fire and explosion. Estimated cost will exceed $40,000.

O., East Palestine—W. S. George Pottery Co., East Palestine, plans to construct a second continuous kiln at its No. 4 plant, to be combination circular and decorating and bisque kiln. Estimated cost $40,000.

Pa., Clearfield—Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, A. H. Munro, Dist. Supt., Clearfield, plans to construct a new plant unit to have a capacity of 75,000 standard 9 in. bricks daily. Estimated cost will exceed $65,000.

Tenn., Chattanooga—War Dept., 20th and Constitution Aves., Wash., D. C., plans to expand sulphuric acid plant at Copper Hill, Tenn. Plant will be operated by Tennessee Copper Co. of New York. Estimated cost $2,375,000.

Tex., San Diego—Trinity Gas Corp., Magnolia Bldg., Dallas, plans to construct a recycling plant in the Sejita Fields near here. Estimated cost $800,000.

Va., Staunton—Staunton Textile Corp., subsidiary of Celanese Corp. of America, 180 Madison Ave., New York, N. Y., plans to construct a celanese plant here. Estimated cost $500,000.

Wash., Tacoma—Philadelphia Quartz Co., Sixth and Grayson Sts., Berkeley, Calif., plans to construct a chemical plant here. Estimated cost $250,000.

B. C., Ashcraft—Ashcraft Salts, Ltd., 7 Railway Ave., plans to construct a plant. Estimated cost $40,000.

Ont., Toronto—Seiberling Rubber Co. of Canada, Ltd., 99 Paton Rd., Toronto, plans to construct an addition to its plant. Estimated cost of building $100,000; equipment $200,000.

CONTRACTS AWARDED

Ala., Sylacauga—War Dept., 20th and Constitution Ave., N. W., Wash., D. C., has awarded the contract for a plant here for the manufacture of TNT, DNT and Tetryl to E. I. du Pont de Nemours & Co., Du Pont Bldg., Wilmington, Del. Estimated cost $24,675,000.

Ark., Marche—War Dept., 20th and Constitution Aves., Wash., D. C., has awarded the contract for the design and construction of a picric acid plant to be known as Maumelle Ordnance Works, to Lummus Co., 420 Lexington Ave., New York, N. Y. Estimated cost $8,000,000.

Calif., Oakland—Dewey & Almy Chemical Co., 4000 East 8th St., has awarded the contract for warehouse additions to Christensen & Lyons, 3454 Harlan St., Oakland, at $40,920.

Calif., Redwood City—Pacific Portland Cement Co., Redwood City, has awarded the contract for a warehouse to W. P. Goodenough, 49 Wells Ave., Palo Alto, at $60,000.

Md., Baltimore—Lever Bros. Co., manufacturer of soap and shortenings, has awarded the contract for a plant to Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass. Estimated cost $250,000.

Mo., Weldon Springs—War Dept., 20th and Constitution Aves., Wash., D. C., has awarded the contract for a plant for the manufacture of TNT to Fraser Brace Engineering Co., Inc., 10 East 40th St., New York, N. Y. Plant will be operated by Atlas Powder Co., Wilmington, Del. Estimated cost $20,000,000.

N. J., Bound Brook—Bakelite Corp., 247 Park Ave., New York, N. Y., has awarded the contract for a warehouse, etc., to Turner Construction Co., 420 Lexington Ave., New York, N. Y. Estimated cost $200,000.

N. J., New Brunswick—E. R. Squibb & Sons, 745 Fifth Ave., New York, N. Y., have awarded the contract for a 3 story laboratory to Joseph Muscarelle, Garfield, N. J. Estimated cost $100,000.

N. Y., Niagara Falls—Carborundum Co., Buffalo Ave., has awarded the contract for 3 plant additions to Wright & Kremers, Inc., Main St. and Pine Ave., Niagara Falls. Estimated cost $150,000.

N. Y., West Seneca—Iroquois Gas Corp., Iroquois Bldg., Buffalo, has awarded the contract for a plant building to Hydro Construction Co., Stock Exchange Bldg., Buffalo. Estimated cost $150,000.

Pa., Chester—Scott Paper Co., Market St., has awarded the contract for a plant building to David M. Hunt, 1700 Sansom St., Philadelphia, Pa. Estimated cost $65,000.

Pa., Eddington—Keystone Wood Preserving Co., Poster St., Philadelphia, will construct 80x125 ft. and 40x60 ft. plant buildings. Work will be done by separate contracts. Estimated cost $75,000.

Pa., Mt. Holly Springs—Schweitzer Paper Co., Mt. Holly Springs, will alter, remodel and construct small addition to former plant of Mt. Holly Paper Co. Estimated cost including equipment $100,000.

Tenn., Chattanooga—War Dept., 20th and Constitution Aves., Wash., D. C., has awarded the contract for a plant for the manufacture of TNT to Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass. Estimated cost $9,000,000.

O., Wellsville—Sterling China Co., Wellsville, has awarded the contract for a 70 ft. diametercircular continuous kiln to Allied Engineering Co., 4150 East 56th St., Cleveland. Estimated cost $40,000.

Tex., Corpus Christi—Chicago Corp., Corpus Christi, and c/o Clyde Alexander, Dallas Natl. Bank Bldg., Dallas, has awarded the contract for expansion of existing recycling plant in Stratton Fields to Stearns Roger Manufacturing Co., 1720 California St., Denver, Colo. Estimated cost $450,000.

B. C., Vancouver—Canadian Industries, Ltd., C. I. L. House, Montreal, Que., has awarded the contract for a 1 story, 120x125 ft. chemical storage building to Armstrong & Monteith Construction Co., Ltd., 1383 Hornsby St. Estimated cost $40,000.

Ont., Cornwall—Cornwalls Chemicals, Ltd., Cornwall, has awarded the contract for a 1 story, 90x150 ft. plant to Fraser-Brace Engineering Co., Ltd., 107 Craig St., W., Montreal, Que. Estimated cost $300,000.

Ont., Niagara Falls—Canadian Carborundum Co., Ltd., Stanley St., has awarded the contract for a 1 story furnace building to Robertson Construction & Engineering Co., Ltd., Imperial Bank Chambers. Estimated cost $200,000.

Ont., Toronto—Dominion Tar & Chemical Co., Ltd., Commissioner St., has awarded the contract for an addition to its plant to Redfern Construction Co., Ltd., 36 Toronto St. Estimated cost $225,000.